
**ST. PETE-CLEARWATER INTERNATIONAL AIRPORT**

# GENERAL CONTRACT PROVISIONS AND TECHNICAL SPECIFICATIONS

**FOR**

# RELOCATE AIRFIELD ELECTRICAL VAULT

**FAA AIP PROJECT NUMBER: 3-12-0075-xxx-xxxx**

**Prepared By**

## AECOM

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# TABLE OF CONTENTS
# RELOCATE AIRFIELD ELECTRICAL VAULT AT
# ST. PETE-CLEARWATER INTERNATIONAL AIRPORT

**DIVISION 26 - ELECTRICAL**

**DIVISION 31 - EARTHWORK**



**APPENDIX**

# GENERAL CONTRACT PROVISIONS

# SECTION 10 DEFINITION OF TERMS

When the following terms are used in these specifications, in the contract, or in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be defined as follows:

| Paragraph Number | Term | Definition |
|---|---|---|
| **10-01** | **AASHTO** | The American Association of State Highway and Transportation Officials. |
| **10-02** | **Access Road** | The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public roadway. |
| **10-03** | **Advertisement** | A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished. |
| **10-04** | **Airport** | Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; airport buildings and facilities located in any of these areas, and a heliport. |
| **10-05** | **Airport Improvement Program (AIP)** | A grant-in-aid program, administered by the Federal Aviation Administration (FAA). |
| **10-06** | **Air Operations Area (AOA)** | The term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron. |
| **10-07** | **Apron** | Area where aircraft are parked, unloaded or loaded, fueled and/or serviced. |
| **10-08** | **ASTM International (ASTM)** | Formerly known as the American Society for Testing and Materials (ASTM). |
| **10-09** | **Award** | The Owner's notice to the successful bidder of the acceptance of the submitted bid. |
| **10-10** | **Bidder** | Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated. |
| **10-11** | **Building Area** | An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon. |
| **10-12** | **Calendar Day** | Every day shown on the calendar. |
| **10-13** | **Certificate of Analysis (COA)** | The COA is the manufacturer's Certificate of Compliance (COC) including all applicable test results required by the specifications. |

| Paragraph Number | Term | Definition |
|---|---|---|
| **10-14** | **Certificate of Compliance (COC)** | The manufacturer's certification stating that materials or assemblies furnished fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer's authorized representative. |
| **10-15** | **Change Order** | A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for work within the scope of the contract and necessary to complete the project. |
| **10-16** | **Contract** | A written agreement between the Owner and the Contractor that establishes the obligations of the parties including but not limited to performance of work, furnishing of labor, equipment and materials and the basis of payment.<br><br>The awarded contract includes but may not be limited to: Advertisement, Contract form, Proposal, Performance bond, payment bond, General provisions, certifications and representations, Technical Specifications, Plans, Supplemental Provisions, standards incorporated by reference and issued addenda. |
| **10-17** | **Contract Item (Pay Item)** | A specific unit of work for which a price is provided in the contract. |
| **10-18** | **Contract Time** | The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the contract shall be completed by that date. |
| **10-19** | **Contractor** | The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work. |
| **10-20** | **Contractors Quality Control (QC) Facilities** | The Contractor's QC facilities in accordance with the Contractor Quality Control Program (CQCP). |
| **10-21** | **Contractor Quality Control Program (CQCP)** | Details the methods and procedures that will be taken to assure that all materials and completed construction required by the contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. |
| **10-22** | **Control Strip** | A demonstration by the Contractor that the materials, equipment, and construction processes results in a product meeting the requirements of the specification. |
| **10-23** | **Construction Safety and Phasing Plan (CSPP)** | The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport |

| Paragraph Number | Term | Definition |
|---|---|---|
| | | operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications. |
| **10-24** | **Drainage System** | The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area. |
| **10-25** | **Engineer** | The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering, inspection, and/or observation of the contract work and acting directly or through an authorized representative. |
| **10-26** | **Equipment** | All machinery, together with the necessary supplies for upkeep and maintenance; and all tools and apparatus necessary for the proper construction and acceptable completion of the work. |
| **10-27** | **Extra Work** | An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Owner's Engineer or Resident Project Representative (RPR) to be necessary to complete the work within the intended scope of the contract as previously modified. |
| **10-28** | **FAA** | The Federal Aviation Administration. When used to designate a person, FAA shall mean the Administrator or their duly authorized representative. |
| **10-29** | **Federal Specifications** | The federal specifications and standards, commercial item descriptions, and supplements, amendments, and indices prepared and issued by the General Services Administration. |
| **10-30** | **Force Account** | **a.** Contract Force Account - A method of payment that addresses extra work performed by the Contractor on a time and material basis.<br><br>**b.** Owner Force Account - Work performed for the project by the Owner's employees. |
| **10-31** | **Intention of Terms** | Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer and/or Resident Project Representative (RPR) is intended; and similarly, the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer and/or RPR, subject in each case to the final determination of the Owner.<br><br>Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such |

| Paragraph Number | Term | Definition |
|---|---|---|
| | | specific reference. |
| **10-32** | **Lighting** | A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface. |
| **10-33** | **Major and Minor Contract Items** | A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20% of the total amount of the award contract. All other items shall be considered minor contract items. |
| **10-34** | **Materials** | Any substance specified for use in the construction of the contract work. |
| **10-35** | **Modification of Standards (MOS)** | Any deviation from standard specifications applicable to material and construction methods in accordance with FAA Order 5300.1. |
| **10-36** | **Notice to Proceed (NTP)** | A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins. |
| **10-37** | **Owner** | The term "Owner" shall mean the party of the first part or the contracting agency signatory to the contract. Where the term "Owner" is capitalized in this document, it shall mean airport Sponsor only. The Owner for this project is **St. Pete-Clearwater International Airport (PIE).** |
| 10-38 | **Passenger Facility Charge (PFC)** | Per 14 Code of Federal Regulations (CFR) Part 158 and 49 United States Code (USC) § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls. |
| **10-39** | **Pavement Structure** | The combined surface course, base course(s), and subbase course(s), if any, considered as a single unit. |
| **10-40** | **Payment bond** | The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work. |
| **10-41** | **Performance bond** | The approved form of security furnished by the Contractor and their own surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract. |
| **10-42** | **Plans** | The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications. Plans may also be referred to as 'contract drawings.' |

| Paragraph Number | Term | Definition |
|---|---|---|
| **10-43** | **Project** | The agreed scope of work for accomplishing specific airport development with respect to a particular airport. |
| **10-44** | **Proposal** | The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications. |
| **10-45** | **Proposal guaranty** | The security furnished with a proposal to guarantee that the bidder will enter into a contract if their own proposal is accepted by the Owner. |
| **10-46** | **Quality Assurance (QA)** | Owner's responsibility to assure that construction work completed complies with specifications for payment. |
| **10-47** | **Quality Control (QC)** | Contractor's responsibility to control material(s) and construction processes to complete construction in accordance with project specifications. |
| **10-48** | **Quality Assurance (QA) Inspector** | An authorized representative of the Engineer and/or Resident Project Representative (RPR) assigned to make all necessary inspections, observations, tests, and/or observation of tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor. |
| **10-49** | **Quality Assurance (QA) Laboratory** | The official quality assurance testing laboratories of the Owner or such other laboratories as may be designated by the Engineer or RPR. May also be referred to as Engineer's, Owner's, or QA Laboratory. |
| **10-50** | **Resident Project Representative (RPR)** | The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for all necessary inspections, observations, tests, and/or observations of tests of the contract work performed or being performed, or of the materials furnished or being furnished by the Contractor, and acting directly or through an authorized representative. |
| **10-51** | **Runway** | The area on the airport prepared for the landing and takeoff of aircraft. |
| **10-52** | **Runway Safety Area (RSA)** | A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft. See the construction safety and phasing plan (CSPP) for limits of the RSA. |
| **10-53** | **Safety Plan Compliance Document (SPCD)** | Details how the Contractor will comply with the CSPP. |
| **10-54** | **Specifications** | A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as |

| Paragraph Number | Term | Definition |
|---|---|---|
| | | if included in the contract physically. |
| **10-55** | **Sponsor** | A Sponsor is defined in 49 USC § 47102(24) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport. |
| **10-56** | **Structures** | Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein. |
| **10-57** | **Subgrade** | The soil that forms the pavement foundation. |
| **10-58** | **Superintendent** | The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the RPR, and who shall supervise and direct the construction. |
| **10-59** | **Supplemental Agreement** | A written agreement between the Contractor and the Owner that establishes the basis of payment and contract time adjustment, if any, for the work affected by the supplemental agreement. A supplemental agreement is required if: (1) in scope work would increase or decrease the total amount of the awarded contract by more than 25%: (2) in scope work would increase or decrease the total of any major contract item by more than 25%; (3) work that is not within the scope of the originally awarded contract; or (4) adding or deleting of a major contract item. |
| **10-60** | **Surety** | The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor. |
| **10-61** | **Taxilane** | A taxiway designed for low speed movement of aircraft between aircraft parking areas and terminal areas. |
| **10-62** | **Taxiway** | The portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways, aircraft parking areas, and terminal areas. |
| **10-63** | **Taxiway/Taxilane Safety Area (TSA)** | A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft. See the construction safety and phasing plan (CSPP) for limits of the TSA. |
| **10-64** | **Work** | The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications. |
| **10-65** | **Working day** | A working day shall be any day other than a legal holiday, |

| Paragraph Number | Term | Definition |
|---|---|---|
| | | Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days. |
| **10-66** | **Owner Defined terms** | ***Owner's Authorized Representative (OAR) – A person under contract with PIE and authorized by PIE to inspect, reject or accept work performed by the General Contractor. OAR and Resident Project Representative (RPR) are used interchangeably.***<br><br>***Advisory Circular (AC) – A document issued by the FAA containing informational material and guidance. When referred to in the drawings (plans) and specifications, advisory circulars shall have the same force a supplemental specifications.***<br><br>***Certification – When "certification" issued to describe that which is to be submitted for approval from the Contractor, jointly with a supplier or by himself for his own materials, whether manufactured or purchased by the Contractor, will be construed to mean compliance in individual or completed form with the drawings (plans), specifications and/or intent of the design.***<br><br>***Awarded Contract – The written agreement between the Owner and Contractor, covering the work to be performed. The awarded Contract shall include, but is not limited to: The Advertisement; The Contract Form; The Proposal; The Performance Bond and Payment Bond; any required insurance certificates; The General Provisions; The General Requirements; The Special Provisions; The Specifications; Standard Forms; The Drawings (Plans), and addenda issued to bidders, Change Orders Terms and Conditions, and agreements which are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.***<br><br>***Special Provisions – The specific clauses setting forth conditions or requirements peculiar to the project under consideration.***<br><br>***Subcontractor – The pre-qualified (where required) individual, partnership or corporation, or a combination thereof, undertaking the execution of a part of the work under the terms of the Contract, by virtue of an agreement with the contractor approved by the Owner.*** |

## END OF SECTION 10

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# SECTION 20 PROPOSAL REQUIREMENTS AND CONDITIONS

~~**20-01 Advertisement (Notice to Bidders).** ***Is an official published advertisement, also known as Invitation to Bid (ITB), that states the time and place for submitting sealed proposals; a description of the proposed work; instructions to bidders as to obtaining proposal forms; plans, and specifications; proposal guaranty required; and the Owner's right to reject any and all bids.***~~

~~**20-02 Qualification of bidders**. Each bidder shall submit evidence of competency and evidence of financial responsibility to perform the work to the Owner at the time of bid opening.~~

~~Evidence of competency, unless otherwise specified, shall consist of statements covering the bidder's past experience on similar work, and a list of equipment and a list of key personnel that would be available for the work.~~

~~Each bidder shall furnish the Owner satisfactory evidence of their financial responsibility. Evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's financial resources and liabilities as of the last calendar year or the bidder's last fiscal year. Such statements or reports shall be certified by a public accountant. At the time of submitting such financial statements or reports, the bidder shall further certify whether their financial responsibility is approximately the same as stated or reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify the public accountant's statement or report to reflect the bidder's true financial condition at the time such qualified statement or report is submitted to the Owner.~~

~~Unless otherwise specified, a bidder may submit evidence that they are prequalified with the State Highway Division and are on the current "bidder's list" of the state in which the proposed work is located. Evidence of State Highway Division prequalification may be submitted as evidence of financial responsibility in lieu of the certified statements or reports specified above.~~

**20-03 Contents of proposal forms**. The Owner's proposal forms state the location and description of the proposed construction; the place, date, and time of opening of the proposals; and the estimated quantities of the various items of work to be performed and materials to be furnished for which unit bid prices are asked. The proposal form states the time in which the work must be completed, and the amount of the proposal guaranty that must accompany the proposal. The Owner will accept only those Proposals properly executed on physical forms or electronic forms provided by the Owner. Bidder actions that may cause the Owner to deem a proposal irregular are given in paragraph 20-09 *Irregular proposals*.

Mobilization is limited to **10** percent of the total project cost.

~~A prebid conference is required on this project to discuss as a minimum, the following items: material requirements; submittals; Quality Control/Quality Assurance requirements; the construction safety and phasing plan including airport access and staging areas; and unique airfield paving construction requirements.~~

**20-04 Issuance of proposal forms**. The Owner reserves the right to refuse to issue a proposal form to a prospective bidder if the bidder is in default for any of the following reasons:

~~**a.** Failure to comply with any prequalification regulations of the Owner, if such regulations are cited, or otherwise included, in the proposal as a requirement for bidding.~~

**b.** Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force with the Owner at the time the Owner issues the proposal to a prospective bidder.

~~**c.** Documented record of Contractor default under previous contracts with the Owner.~~

~~**d.** Documented record of unsatisfactory work on previous contracts with the Owner.~~

**20-05 Interpretation of estimated proposal quantities**. An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The Owner does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. ***The Contractor shall verify all quantities as noted in the plans prior to ordering material or equipment. No additional***

***compensation shall be made for stored materials, re-stocking fees or other fees associated with errors in quantity calculations.*** It is understood that the quantities may be increased or decreased as provided in the Section 40, paragraph 40-02, Alteration of Work and Quantities, without in any way invalidating the unit bid prices.

**20-06 Examination of plans, specifications, and site**. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves to the character, quality, and quantities of work to be performed, materials to be furnished, and to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied to the conditions to be encountered in performing the work and the requirements of the proposed contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, was obtained and is intended for the Owner's design and estimating purposes only. Such information has been made available for the convenience of all bidders. It is further understood and agreed that each bidder is solely responsible for all assumptions, deductions, or conclusions which the bidder may make or obtain from their own examination of the boring logs and other records of subsurface investigations and tests that are furnished by the Owner.

~~**20-07 Preparation of proposal**. The bidder shall submit their proposal on the forms furnished by the Owner. All blank spaces in the proposal forms, unless explicitly stated otherwise, must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink or typed) both in words and numerals which they propose for each pay item furnished in the proposal. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.~~

~~The bidder shall correctly sign the proposal in ink. If the proposal is made by an individual, their name and post office address must be shown. If made by a partnership, the name and post office address of each member of the partnership must be shown. If made by a corporation, the person signing the proposal shall give the name of the state where the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of their authority to do so and that the signature is binding upon the firm or corporation.~~

~~**20-08 Responsive and responsible bidder.** A responsive bid conforms to all significant terms and conditions contained in the Owner's invitation for bid. It is the Owner's responsibility to decide if the exceptions taken by a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.~~

~~A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed procurement, as defined in 2 CFR § 200.318(h). This includes such matters as Contractor integrity, compliance with public policy, record of past performance, and financial and technical resources.~~

~~**20-09 Irregular proposals**. Proposals shall be considered irregular for the following reasons:~~

~~**a.** If the proposal is on a form other than that furnished by the Owner, or if the Owner's form is altered, or if any part of the proposal form is detached.~~

~~**b.** If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind that make the proposal incomplete, indefinite, or otherwise ambiguous.~~

~~**c.** If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the bidder is not required to furnish a unit price.~~

~~**d.** If the proposal contains unit prices that are obviously unbalanced.~~

~~**e.** If the proposal is not accompanied by the proposal guaranty specified by the Owner.~~

~~**f.** If the applicable Disadvantaged Business Enterprise information is incomplete.~~

~~The Owner reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the Owner and conforms to local laws and ordinances pertaining to the letting of construction contracts.~~

**20-10 Bid guarantee**. Each separate proposal shall be accompanied by a bid bond, certified check, or other specified acceptable collateral, in the amount specified in the proposal form. Such bond, check, or collateral, shall be made payable to the Owner.

**20-11 Delivery of proposal.** ***Delivery of proposal shall comply with the ITB.***

**20-12 Withdrawal or revision of proposals**. A bidder may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the bidder's request for withdrawal is received by the Owner in writing ***or*** by email before the time specified for opening bids. Revised proposals must be received at the place specified in the advertisement before the time specified for opening all bids.

**20-13 Public opening of proposals**. Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the bidder unopened.

**20-14 Disqualification of bidders**. A bidder shall be considered disqualified for any of the following reasons:

**a.** Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.

**b.** Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Owner until any such participating bidder has been reinstated by the Owner as a qualified bidder.

**c.** If the bidder is considered to be in "default" for any reason specified in paragraph 20-04, *Issuance of Proposal Forms,* of this section.

**20-15 Discrepancies and Omissions.** A Bidder who discovers discrepancies or omissions with the project bid documents shall immediately notify the Owner's Engineer of the matter. A bidder that has doubt as to the true meaning of a project requirement may submit to the Owner's Engineer a written request for interpretation no later than **10** days prior to bid opening.

Any interpretation of the project bid documents by the Owner's Engineer will be by written addendum issued by the Owner. The Owner will not consider any instructions, clarifications or interpretations of the bidding documents in any manner other than written addendum.

## END OF SECTION 20

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# SECTION 30 AWARD AND EXECUTION OF CONTRACT

**30-01 Consideration of proposals**. After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit bid price written in words shall govern.

Until the award of a contract is made, the Owner reserves the right to reject a bidder's proposal for any of the following reasons:

**a.** If the proposal is irregular as specified in Section 20, paragraph 20-09, *Irregular Proposals*.

**b.** If the bidder is disqualified for any of the reasons specified Section 20, paragraph 20-14, *Disqualification of Bidders*.

In addition, until the award of a contract is made, the Owner reserves the right to reject any or all proposals, waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable state and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the Owner's best interests.

**30-02 Award of contract**. The award of a contract, if it is to be awarded, shall be made within **180** calendar days of the date specified for publicly opening proposals, unless otherwise specified herein.

**Basis of Award shall comply with the ITB.**

If the Owner elects to proceed with an award of contract, the Owner will make award to the responsible bidder whose bid, conforming with all the material terms and conditions of the bid documents, is the lowest in price.

***The Owner shall evaluate the bids and award this contract based on the lowest responsive price for the base bid.***

***Unless otherwise specified in this subsection, no award shall be made until the FAA has concurred in the Owner's recommendation to make such award and has approved the Owner's proposed contract to the extent that such concurrence and approval are required by 49 CFR Part 18.***

**30-03 Cancellation of award**. The Owner reserves the right to cancel the award without liability to the bidder, except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is approved by the Owner in accordance with paragraph 30-07 *Approval of Contract*.

**30-04 Return of proposal guaranty**. All proposal guaranties, except those of the two lowest bidders, will be returned immediately after the Owner has made a comparison of bids as specified in the paragraph 30-01, *Consideration of Proposals*. Proposal guaranties of the two lowest bidders will be retained by the Owner until such time as an award is made, at which time, the unsuccessful bidder's proposal guaranty will be returned. The successful bidder's proposal guaranty will be returned as soon as the Owner receives the contract bonds as specified in paragraph 30-05, *Requirements of Contract Bonds*.

**30-05 Requirements of contract bonds**. At the time of the execution of the contract, the successful bidder shall furnish the Owner a surety bond or bonds that have been fully executed by the bidder and the surety guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable to the Owner. Unless otherwise specified in this subsection, the surety bond or bonds shall be in a sum equal to the full amount of the contract.

**30-06 Execution of contract**. The successful bidder shall sign (execute) the necessary agreements for entering into the contract and return the signed contract to the Owner, along with the fully executed surety bond or bonds specified in paragraph 30-05, *Requirements of Contract Bonds,* of this section, within **15** calendar days from the date mailed or otherwise delivered to the successful bidder.

**30-07 Approval of contract**. Upon receipt of the contract and contract bond or bonds that have been executed by the successful bidder, the Owner shall complete the execution of the contract in accordance with local laws or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract to the

~~Contractor shall constitute the Owner's approval to be bound by the successful bidder's proposal and the terms of the contract.~~

~~**30-08 Failure to execute contract**. Failure of the successful bidder to execute the contract and furnish an acceptable surety bond or bonds within the period specified in paragraph 30-06, *Execution of Contract,* of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidated damages to the Owner.~~

## END OF SECTION 30

# SECTION 40 SCOPE OF WORK

**40-01 Intent of contract**. The intent of the contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

~~**40-02 Alteration of work and quantities**. The Owner reserves the right to make such changes in quantities and work as may be necessary or desirable to complete, in a satisfactory manner, the original intended work. Unless otherwise specified in the Contract, the Owner's Engineer or RPR shall be and is hereby authorized to make, in writing, such in scope alterations in the work and variation of quantities as may be necessary to complete the work, provided such action does not represent a significant change in the character of the work.~~

~~For purpose of this section, a significant change in character of work means: any change that is outside the current contract scope of work; any change (increase or decrease) in the total contract cost by more than 25%; or any change in the total cost of a major contract item by more than 25%.~~

~~Work alterations and quantity variances that do not meet the definition of significant change in character of work shall not invalidate the contract nor release the surety. Contractor agrees to accept payment for such work alterations and quantity variances in accordance with Section 90, paragraph 90-03, *Compensation for Altered Quantities*.~~

~~Should the value of altered work or quantity variance meet the criteria for significant change in character of work, such altered work and quantity variance shall be covered by a supplemental agreement. Supplemental agreements shall also require consent of the Contractor's surety and separate performance and payment bonds. If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the Owner reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.~~

~~**40-03 Omitted items**. The Owner, the Owner's Engineer or the RPR may provide written notice to the Contractor to omit from the work any contract item that does not meet the definition of major contract item. Major contract items may be omitted by a supplemental agreement. Such omission of contract items shall not invalidate any other contract provision or requirement.~~

~~Should a contract item be omitted or otherwise ordered to be non performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to omit such item. Payment for work performed shall be in accordance with Section 90, paragraph 90-04, *Payment for Omitted Items*.~~

~~**40-04 Extra work**. Should acceptable completion of the contract require the Contractor to perform an item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, Owner may issue a Change Order to cover the necessary extra work. Change orders for extra work shall contain agreed unit prices for performing the change order work in accordance with the requirements specified in the order, and shall contain any adjustment to the contract time that, in the RPR's opinion, is necessary for completion of the extra work.~~

~~When determined by the RPR to be in the Owner's best interest, the RPR may order the Contractor to proceed with extra work as provided in Section 90, paragraph 90-05, *Payment for Extra Work*. Extra work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original contract shall be covered by a supplemental agreement as defined in Section 10, paragraph 10-59, *Supplemental Agreement*.~~

~~If extra work is essential to maintaining the project critical path, RPR may order the Contractor to commence the extra work under a Time and Material contract method. Once sufficient detail is available to establish the level of effort necessary for the extra work, the Owner shall initiate a change order or supplemental agreement to cover the extra work.~~

~~Any claim for payment of extra work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the Owner.~~

**40-05 Maintenance of traffic**. It is the explicit intention of the contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration. The Contractor shall maintain traffic in the manner detailed in the Construction Safety and Phasing Plan (CSPP).

**a.** It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas (AOAs) of the airport with respect to their own operations and the operations of all subcontractors as specified in Section 80, paragraph 80-04, *Limitation of Operations*. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in Section 70, paragraph 70-15, *Contractor's Responsibility for Utility Service and Facilities of Others*.

**b.** With respect to their own operations and the operations of all subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying personnel, equipment, vehicles, storage areas, and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport in accordance with the construction safety and phasing plan (CSPP) and the safety plan compliance document (SPCD) ***AC150/5370-2, current issue***. Refer to AC 150/5210-5, Painting, Marking and Lighting of Vehicles Used on an Airport and AC 150/5370-2, Operational Safety on Airports During Construction for applicable standards.

**c.** When the contract requires the maintenance of an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep the road, street, or highway open to all traffic and shall provide maintenance as may be required to accommodate traffic. The Contractor, at their expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD) (http://mutcd.fhwa.dot.gov/), ***and to FDOT section 102 – Maintenance of traffic,*** unless otherwise specified. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified herein, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

**40-06 Removal of existing structures**. All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plans, the Resident Project Representative (RPR) shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the RPR in accordance with the provisions of the contract.

Except as provided in Section 40, paragraph 40-07, *Rights in and Use of Materials Found in the Work*, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be used in the work as otherwise provided for in the contract and shall remain the property of the Owner when so used in the work.

**40-07 Rights in and use of materials found in the work**. Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the contract to be embankment, the Contractor may at their own option either:

**a.** Use such material in another contract item, providing such use is approved by the RPR and is in conformance with the contract specifications applicable to such use; or,

**b.** Remove such material from the site, upon written approval of the RPR; or

**c.** Use such material for the Contractor's own temporary construction on site; or,

**d.** Use such material as intended by the terms of the contract.

Should the Contractor wish to exercise option a., b., or c., the Contractor shall request the RPR's approval in advance of such use.

Should the RPR approve the Contractor's request to exercise option a., b., or c., the Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The Contractor shall replace, at their

expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the contract work. The Contractor shall not be charged for use of such material used in the work or removed from the site.

Should the RPR approve the Contractor's exercise of option a., the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of their own exercise of option a., b., or c.

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the contract, plans, or specifications.

**40-08 Final cleanup**. Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. The Contractor shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of the property Owner.

## END OF SECTION 40

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# SECTION 50 CONTROL OF WORK

**50-01 Authority of the Resident Project Representative (RPR)**. The RPR has final authority regarding the interpretation of project specification requirements. The RPR shall determine acceptability of the quality of materials furnished, method of performance of work performed, and the manner and rate of performance of the work. The RPR does not have the authority to accept work that does not conform to specification requirements.

**50-02 Conformity with plans and specifications**. All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross-sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the contract, plans, or specifications.

If the RPR finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications, but that the portion of the work affected will, in their opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the Owner, the RPR will advise the Owner of their determination that the affected work be accepted and remain in place. The RPR will document the determination and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price for the affected portion of the work. Changes in the contract price must be covered by contract change order or supplemental agreement as applicable.

If the RPR finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the RPR's written orders.

The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans, and specifications. The term shall not be construed as waiving the RPR's responsibility to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's execution of the work, when, in the RPR's opinion, such compliance is essential to provide an acceptable finished portion of the work.

The term "reasonably close conformity" is also intended to provide the RPR with the authority, after consultation with the Sponsor and FAA, to use sound engineering judgment in their determinations to accept work that is not in strict conformity, but will provide a finished product equal to or better than that required by the requirements of the contract, plans and specifications.

The RPR will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.

**50-03 Coordination of contract, plans, and specifications**. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. If electronic files are provided and used on the project and there is a conflict between the electronic files and hard copy plans, the hard copy plans shall govern. A requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; contract technical specifications shall govern over contract general provisions, plans, cited standards for materials or testing, and cited advisory circulars (ACs); contract general provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern over cited standards for materials or testing and cited ACs. If any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits, and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test methods, the Contractor shall immediately ask the RPR for an interpretation and decision, and such decision shall be final.

The Contractor shall not take advantage of any apparent error or omission on the plans or specifications. In the event the Contractor discovers any apparent error or discrepancy, Contractor shall immediately notify the Owner or the designated representative in writing requesting their written interpretation and decision.

**50-04 List of Special Provisions. Refer to Invitation to Bid.**

**50-05 Cooperation of Contractor**. The Contractor shall be supplied with **two** hard copies or an electronic PDF of the plans and specifications. The Contractor shall have available on the construction site at all times one hardcopy

each of the plans and specifications. Additional hard copies of plans and specifications may be obtained by the Contractor for the cost of reproduction.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate with the RPR and their inspectors and with other Contractors in every way possible. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as their agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the RPR or their authorized representative.

**50-06 Cooperation between Contractors**. The Owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct the work not to interfere with or hinder the progress of completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with their own contract and shall protect and hold harmless the Owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange their work and shall place and dispose of the materials being used to not interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join their work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

**50-07 Construction layout and stakes**. The Engineer/RPR shall establish necessary horizontal and vertical control. The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor. Contractor is responsible for preserving integrity of horizontal and vertical controls established by Engineer/RPR. In case of negligence on the part of the Contractor or their employees, resulting in the destruction of any horizontal and vertical control, the resulting costs will be deducted as a liquidated damage against the Contractor.

Prior to the start of construction, the Contractor will check all control points for horizontal and vertical accuracy and certify in writing to the RPR that the Contractor concurs with survey control established for the project. All lines, grades and measurements from control points necessary for the proper execution and control of the work on this project will be provided to the RPR. The Contractor is responsible to establish all layout required for the construction of the project.

Copies of survey notes will be provided to the RPR for each area of construction and for each placement of material as specified to allow the RPR to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. Surveys will be provided to the RPR prior to commencing work items that cover or disturb the survey staking. Survey(s) and notes shall be provided in the following format(s): ***AutoCAD 2018 or higher and two hard copy plans 22x34 signed and sealed by a licensed land surveyor***.

Laser, GPS, String line, or other automatic control shall be checked with temporary control as necessary. In the case of error, on the part of the Contractor, their surveyor, employees or subcontractors, resulting in established grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional cost to the Owner.

***Construction Staking and Layout includes but is not limited to:***

- ***a. Clearing and Grubbing perimeter staking***
- ***b. Rough Grade slope stakes at 100-foot (30-m) stations***
- ***c. Drainage Swales slope stakes and flow line blue tops at 50-foot (15-m) stations***

***Subgrade blue tops at 25-foot (7.5-m) stations and 25-foot (7.5-m) offset distance (maximum) for the following section locations:***

- ***a. Runway – minimum five (5) per station***
- ***b. Taxiways – minimum three (3) per station***
- ***c. Holding apron areas – minimum three (3) per station***

*d. Roadways – minimum three (3) per station*

***Base Course blue tops at 25-foot (7.5-m) stations and 25-foot (7.5-m) offset distance (maximum) for the following section locations:***

*a. Runway – minimum five (5) per station*
*b. Taxiways – minimum three (3) per station*
*c. Holding apron areas – minimum three (3) per station*

***Pavement areas:***

*a. Edge of Pavement hubs and tacks (for stringline by Contractor) at 100-foot (30-m) stations.*

*b. Between Lifts at 25-foot (7.5-m) stations for the following section locations:*

*(1) Runways – each paving lane width*
*(2) Taxiways – each paving lane width*
*(3) Holding areas – each paving lane width*

*c. After finish paving operations at 50-foot (15-m) stations:*

*(1) All paved areas – Edge of each paving lane prior to next paving lot*

*d. Shoulder and safety area blue tops at 50-foot (15-m) stations and at all break points with maximum of 50-foot (15-m) offsets.*

*e. Fence lines at 100-foot (30-m) stations minimum.*

*f. Electrical and Communications System locations, lines and grades including but not limited to duct runs, connections, fixtures, signs, lights, Visual Approach Slope Indicators (VASIs), Precision Approach Path Indicators (PAPIs), Runway End Identifier Lighting (REIL), Wind Cones, Distance Markers (signs), pull boxes and manholes.*

*g. Drain lines, cut stakes and alignment on 25-foot (7.5-m) stations, inlet and manholes.*

*h. Painting and Striping layout (pinned with 1.5 inch PK nails) marked for paint Contractor, (All nails shall be removed after painting).*

*i. Laser, or other automatic control devices, shall be checked with temporary control point or grade hub at a minimum of once per 400 feet (120 m) per pass (that is, paving lane).*

*The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor.*

*Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the RPR without additional cost to the Owner.*

No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses. The cost shall be included in the price of the bid for the various items of the Contract.

**50-08 Authority and duties of Quality Assurance (QA) inspectors**. QA inspectors shall be authorized to inspect all work done and all material furnished. Such QA inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. QA inspectors are not authorized to revoke, alter, or waive any provision of the contract. QA inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

QA Inspectors are authorized to notify the Contractor or their representatives of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the RPR for a decision.

**50-09 Inspection of the work**. All materials and each part or detail of the work shall be subject to inspection. The RPR shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the RPR requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Provide advance written notice to the RPR of work the Contractor plans to perform each week and each day. Any work done or materials used without written notice and allowing opportunity for inspection by the RPR may be ordered removed and replaced at the Contractor's expense.

Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (contract) Owner, authorized representatives of the Owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract, and shall in no way interfere with the rights of the parties to this contract.

**50-10 Removal of unacceptable and unauthorized work**. All work that does not conform to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the RPR as provided in paragraph 50-02, *Conformity with Plans and Specifications*.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of Section 70, paragraph 70-14, *Contractor's Responsibility for Work*.

No removal work made under provision of this paragraph shall be done without lines and grades having been established by the RPR. Work done contrary to the instructions of the RPR, work done beyond the lines shown on the plans or as established by the RPR, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply with any order of the RPR made under the provisions of this subsection, the RPR will have authority to cause unacceptable work to be remedied or removed and replaced; and unauthorized work to be removed and recover the resulting costs as a liquidated damage against the Contractor.

**50-11 Load restrictions**. The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor, at their own expense, shall be responsible for the repair to equal or better than preconstruction conditions of any damage caused by the Contractor's equipment and personnel. The Contractor must check to see if the on-site project access roads and haul routes will support the construction equipment. Particular attention should be paid when sections of existing airfield pavements will be used as haul routes to assure that existing pavements are not overloaded. The Contractor shall preserve or rehabilitate any access roads or haul routes to its initial conditions. Videotape or photographs shall be required to document existing conditions prior to start of construction. Construction traffic should be kept off airport pavements to the extent possible.

**50-12 Maintenance during construction**. The Contractor shall maintain the work during construction and until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such work.

**50-13 Failure to maintain the work**. Should the Contractor at any time fail to maintain the work as provided in paragraph 50-12, *Maintenance during Construction*, the RPR shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the exigency that exists.

Should the Contractor fail to respond to the RPR's notification, the Owner may suspend any work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the Owner, shall be recovered as a liquidated damage against the Contractor.

**50-14 Partial acceptance**. If at any time during the execution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the Contractor may request the RPR to make final inspection of that unit. If the RPR finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, the RPR may accept it as being complete, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the Owner shall not void or alter any provision of the contract.

**50-15 Final acceptance.** Upon due notice from the Contractor of presumptive completion of the entire project, the RPR and Owner will make an inspection. If all construction provided for and contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The RPR shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the RPR will notify the Contractor ***(punch list items)*** and the Contractor shall correct the unsatisfactory work. ***The punch list items shall be corrected by the Contractor within 30 calendar days and prior to any request for final inspection or acceptance***. Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the RPR will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

**50-16 Claims for adjustment and disputes.** If for any reason the Contractor deems that additional compensation is due for work or materials not clearly provided for in the contract, plans, or specifications or previously authorized as extra work, the Contractor shall notify the RPR in writing of their intention to claim such additional compensation before the Contractor begins the work on which the Contractor bases the claim. If such notification is not given or the RPR is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the RPR has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit a written claim to the RPR who will present it to the Owner for consideration in accordance with local laws or ordinances.

Nothing in this subsection shall be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

~~**50-17 Value Engineering Cost Proposal.**~~

~~The provisions of this paragraph will apply only to contracts awarded to the lowest bidder pursuant to competitive bidding.~~

~~On projects with original contract amounts in excess of $100,000, the Contractor may submit to the RPR, in writing, proposals for modifying the plans, specifications or other requirements of the contract for the sole purpose of reducing the cost of construction. The value engineering cost proposal shall not impair, in any manner, the essential functions or characteristics of the project, including but not limited to service life, economy of operation, ease of maintenance, desired appearance, design and safety standards. This provision shall not apply unless the proposal submitted is specifically identified by the Contractor as being presented for consideration as a value engineering proposal.~~

~~Not eligible for value engineering cost proposals are changes in the basic design of a pavement type, runway and taxiway lighting, visual aids, hydraulic capacity of drainage facilities, or changes in grade or alignment that reduce the geometric standards of the project.~~

~~As a minimum, the following information shall be submitted by the Contractor with each proposal:~~

~~a. A description of both existing contract requirements for performing the work and the proposed changes, with a discussion of the comparative advantages and disadvantages of each.~~

~~b. An itemization of the contract requirements that must be changed if the proposal is adopted.~~

~~c. A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes.~~

~~d. A statement of the time by which a change order adopting the proposal must be issued.~~

~~e. A statement of the effect adoption of the proposal will have on the time for completion of the contract.~~

~~f. The contract items of work affected by the proposed changes, including any quantity variation attributable to them.~~

~~The Contractor may withdraw, in whole or in part, any value engineering cost proposal not accepted by the RPR, within the period specified in the proposal. The provisions of this subsection shall not be construed to require the RPR to consider any value engineering cost proposal that may be submitted.~~

~~The Contractor shall continue to perform the work in accordance with the requirements of the contract until a change order incorporating the value engineering cost proposal has been issued. If a change order has not been issued by the date upon which the Contractor's value engineering cost proposal specifies that a decision should be made, or such other date as the Contractor may subsequently have requested in writing, such value engineering cost proposal shall be deemed rejected.~~

~~The RPR shall be the sole judge of the acceptability of a value engineering cost proposal and of the estimated net savings from the adoption of all or any part of such proposal. In determining the estimated net savings, the RPR may disregard the contract bid prices if, in the RPR's judgment such prices do not represent a fair measure of the value of the work to be performed or deleted.~~

~~The Owner may require the Contractor to share in the Owner's costs of investigating a value engineering cost proposal submitted by the Contractor as a condition of considering such proposal. Where such a condition is imposed, the Contractor shall acknowledge acceptance of it in writing. Such acceptance shall constitute full authority for the Owner to deduct the cost of investigating a value engineering cost proposal from amounts payable to the Contractor under the contract.~~

~~If the Contractor's value engineering cost proposal is accepted in whole or in part, such acceptance will be by a contract change order that shall specifically state that it is executed pursuant to this paragraph. Such change order shall incorporate the changes in the plans and specifications which are necessary to permit the value engineering cost proposal or such part of it as has been accepted and shall include any conditions upon which the RPR's approval is based. The change order shall also set forth the estimated net savings attributable to the value engineering cost proposal. The net savings shall be determined as the difference in costs between the original contract costs for the involved work items and the costs occurring as a result of the proposed change. The change order shall also establish the net savings agreed upon and shall provide for adjustment in the contract price that will divide the net savings equally between the Contractor and the Owner.~~

~~The Contractor's 50% share of the net savings shall constitute full compensation to the Contractor for the value engineering cost proposal and the performance of the work.~~

~~Acceptance of the value engineering cost proposal and performance of the work shall not extend the time of completion of the contract unless specifically provided for in the contract change order.~~]

***50-18 RETEST OF WORK. When as provided for in the Contract documents, the Owner performs sampling tests of the work and the tests show a failure to meet the requirements of the Contract documents, the expense of retesting, after reworking or substitution by the Contractor will be at the expense of the Contractor and such costs will be deducted from the payments otherwise due to the Contractor.***

***50-19 CORRECTION OF WORK AFTER FINAL PAYMENT. Neither the final certificate, nor payment, nor any provisions in the Contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship and, unless otherwise specified, he shall remedy any defect due thereto and pay for any damage to other work resulting therefrom, which shall appear within a period of one year from date of final acceptance.***

***The Owner shall give notice of observed defects with reasonable promptness. Wherever the word "acceptance" occurs, it shall be understood to mean final acceptance.***

***5-20 WARRANTY AND GUARANTEE. The Contractor warrants to the Owner that all materials furnished under this Contract shall be new unless otherwise specified and that all Work, including without limitation all materials, will be of good quality, free from faults and defects and in conformance with contract requirements. Any work not so conforming to these standards may be considered defective.***

***If, within one year after the date of final acceptance of the Work, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract, any of the Work is found to be defective or not in accordance with Contract requirements, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so.***

***The obligations of the Contractor in this paragraph entitled WARRANTY AND GUARANTEE shall be in addition to and not in limitation of any obligations imposed upon him by special guarantees required by the contract or otherwise prescribed by law.***

## END OF SECTION 50

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# SECTION 60 CONTROL OF MATERIALS

**60-01 Source of supply and quality requirements**. The materials used in the work shall conform to the requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish documentation to the RPR as to the origin, composition, and manufacture of all materials to be used in the work. Documentation shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

***Contractor shall supply steel and manufactured products that conform to the Buy American provisions established under 49 USC Section 50101 as follows: "Steel products must be 100% U.S. domestic product. Preference shall be given to products that are 100% manufactured and assembled in the U.S. Manufactured products not meeting the 100% U.S. domestic preference may only be used on the project of the FAA has officially granted a permissible waiver to Buy American Preferences. Submittals for all manufactured products must include certification of compliance with Buy American requirements as established under 49 USC Section 50101. Submittal must include sufficient information to confirm compliance or submittal will be returned with no action."***

At the RPR's option, materials may be approved at the source of supply before delivery. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

The Contractor shall furnish airport lighting equipment that meets the requirements of the specifications; and is listed in AC 150/5345-53, *Airport Lighting Equipment Certification Program* and *Addendum*, that is in effect on the date of advertisement.

**60-02 Samples, tests, and cited specifications**. All materials used in the work shall be inspected, tested, and approved by the RPR before incorporation in the work unless otherwise designated. Any work in which untested materials are used without approval or written permission of the RPR shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the RPR, shall be removed at the Contractor's expense.

Unless otherwise designated, quality assurance tests will be made by and at the expense of the Owner in accordance with the cited standard methods of ASTM, American Association of State Highway and Transportation Officials (AASHTO), federal specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date of advertisement for bids.

The testing organizations performing on-site quality assurance field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel. Unless otherwise designated, samples for quality assurance will be taken by a qualified representative of the RPR. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at their request after review and approval of the RPR. ***In the event that any tests show a failure to meet the requirements of the Contract Documents, the expense of retesting, after substitution or modification, shall be paid by the Contractor. The Contractor shall furnish the required samples without charge and shall give sufficient notification of the placing of orders for materials to permit testing.***

A copy of all Contractor QC test data shall be provided to the RPR daily, along with printed reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment, the Contractor shall submit a final report to the RPR showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

The Contractor shall employ a Quality Control (QC) testing organization to perform all Contractor required QC tests in accordance with Item C-100 Contractor Quality Control Program (CQCP). ***Final quality control report shall be delivered in an electronic PDF format.***

**60-03 Certification of compliance/analysis (COC/COA)**. The RPR may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's COC stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance

in which the lot is clearly identified. The COA is the manufacturer's COC and includes all applicable test results. ***Certification alone will not relieve the Contractor from his responsibilities to provide materials that comply fully with the provisions of these specifications and that acceptable to the Engineer.***

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the RPR.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "or equal," the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify each lot delivered and shall certify as to:

**a.** Conformance to the specified performance, testing, quality or dimensional requirements; and,

**b.** Suitability of the material or assembly for the use intended in the contract work.

The RPR shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

The RPR reserves the right to refuse permission for use of materials or assemblies on the basis of certificates of compliance.

**60-04 Plant inspection**. The RPR or their authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for acceptance of the material or assembly.

Should the RPR conduct plant inspections, the following conditions shall exist:

**a.** The RPR shall have the cooperation and assistance of the Contractor and the producer with whom the Contractor has contracted for materials.

**b.** The RPR shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.

**c.** If required by the RPR, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Place office or working space in a convenient location with respect to the plant.

It is understood and agreed that the Owner shall have the right to retest any material that has been tested and approved at the source of supply after it has been delivered to the site. The RPR shall have the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or specifications.

~~**60-05 Engineer/ Resident Project Representative (RPR) field office**. The Contractor shall provide dedicated space for the use of the engineer, RPR, and inspectors, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor. The Contractor shall furnish water, sanitary facilities, heat, air conditioning, and electricity ***and other amenities as described in Item M-106.***~~

**60-06 Storage of materials**. Materials shall be stored to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the RPR. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the plans and/or CSPP, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the RPR. Private property shall not be used for storage purposes without written permission of the Owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the RPR a copy of the property Owner's permission.

All storage sites on private or airport property shall be restored to their original condition by the Contractor at their expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

**60-07 Unacceptable materials**. Any material or assembly that does not conform to the requirements of the contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the RPR.

Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned to the site of the work until such time as the RPR has approved its use in the work.

**60-08 Owner furnished materials**. The Contractor shall furnish all materials required to complete the work, except those specified, if any, to be furnished by the Owner. Owner-furnished materials shall be made available to the Contractor at the location specified.

All costs of handling, transportation from the specified location to the site of work, storage, and installing Owner-furnished materials shall be included in the unit price bid for the contract item in which such Owner-furnished material is used.

After any Owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Owner will deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials.

## END OF SECTION 60

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# SECTION 70 LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

**70-01 Laws to be observed**. The Contractor shall keep fully informed of all federal and state laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. The Contractor shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the Owner and all their officers, agents, or servants against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.

**70-02 Permits, licenses, and taxes**. The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful execution of the work.

**70-03 Patented devices, materials, and processes**. If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use by suitable legal agreement with the Patentee or Owner. The Contractor and the surety shall indemnify and hold harmless the Owner, any third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Owner for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the execution or after the completion of the work.

**70-04 Restoration of surfaces disturbed by others**. The Owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the Owner, such authorized work (by others) must be shown on the plans and is indicated ***on the contract plans***. ~~as follows:~~

Except as listed above, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the RPR.

Should the Owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such Owners by arranging and performing the work in this contract to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is listed above. When ordered as extra work by the RPR, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

**70-05 Federal Participation**. The United States Government has agreed to reimburse the Owner for some portion of the contract costs. The contract work is subject to the inspection and approval of duly authorized representatives of the FAA Administrator. No requirement of this contract shall be construed as making the United States a party to the contract nor will any such requirement interfere, in any way, with the rights of either party to the contract.

**70-06 Sanitary, health, and safety provisions**. The Contractor's worksite and facilities shall comply with applicable federal, state, and local requirements for health, safety and sanitary provisions.

**70-07 Public convenience and safety**. The Contractor shall control their operations and those of their subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to their own operations and those of their own subcontractors and all suppliers in accordance with Section 40, paragraph 40-05, *Maintenance of Traffic,* and shall limit such operations for the convenience and safety of the traveling public as specified in Section 80, paragraph 80-04, *Limitation of Operations*.

The Contractor shall remove or control debris and rubbish resulting from its work operations at frequent intervals, and upon the order of the RPR. If the RPR determines the existence of Contractor debris in the work site represents a hazard to airport operations and the Contractor is unable to respond in a prompt and reasonable manner, the RPR

reserves the right to assign the task of debris removal to a third party and recover the resulting costs as a liquidated damage against the Contractor.

**70-08 Construction Safety and Phasing Plan (CSPP).** The Contractor shall complete the work in accordance with the approved Construction Safety and Phasing Plan (CSPP) developed in accordance with AC 150/5370-2, Operational Safety on Airports During Construction. The CSPP is made part of the Project Manual. ~~on sheet(s) [___] of the project plans.~~

**70-09 Use of explosives**. The use of explosives is not permitted on this project.

**70-10 Protection and restoration of property and landscape**. The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Engineer/RPR has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the execution of the work, resulting from any act, omission, neglect, or misconduct in manner or method of executing the work, or at any time due to defective work or materials, and said responsibility shall not be released until the project has been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non-execution thereof by the Contractor, the Contractor shall restore, at their expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

***Work that is to remain in place which is damaged or defaced by reasons of work performed under this Contract, shall be restored at no additional cost to the Owner.***

***Items removed, indicated to be salvaged for Owner or reused in new work, which are damaged beyond repair, shall be replaced with equal new materials under this Contract at no additional cost to the Owner.***

***Existing pavement or other existing work not specified for removal which is temporarily removed, damaged or in any way disturbed or altered by work under this Contract shall be repaired, patched, ore replaced to the complete satisfaction of the RPR at no additional cost to the Owner.***

***Where it is necessary to cut, alter, remove, or temporarily remove and replace existing property or equipment, the cost shall be included in the Contract price for the item creating such work.***

**70-11 Responsibility for damage claims**. The Contractor shall indemnify and hold harmless the Engineer/RPR and the Owner and their officers, agents, and employees from all suits, actions, or claims, of any character, brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree. Money due the Contractor under and by virtue of their own contract considered necessary by the Owner for such purpose may be retained for the use of the Owner or, in case no money is due, their own surety may be held until such suits, actions, or claims for injuries or damages shall have been settled and suitable evidence to that effect furnished to the Owner, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he or she is adequately protected by public liability and property damage insurance.

**70-12 Third party beneficiary clause**. It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of any part of the contract to create for the public or any member thereof, a third-party beneficiary or to authorize anyone not a party to the contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the contract.

**70-13 Opening sections of the work to traffic**. If it is necessary for the Contractor to complete portions of the contract work for the beneficial occupancy of the Owner prior to completion of the entire contract, such "phasing" of the work must be specified below and indicated on the approved Construction Safety and Phasing Plan (CSPP)

and the project plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified.

Upon completion of any portion of work listed above, such portion shall be accepted by the Owner in accordance with Section 50, paragraph 50-14, *Partial Acceptance*.

No portion of the work may be opened by the Contractor until directed by the Owner in writing. Should it become necessary to open a portion of the work to traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the RPR, such portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the Owner shall be repaired by the Contractor at their expense.

The Contractor shall make their own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the contract work.

The Contractor must conform to safety standards contained AC 150/5370-2 and the approved CSPP**.**

Contractor shall refer to the plans, specifications, and the approved CSPP to identify barricade requirements, temporary and/or permanent markings, airfield lighting, guidance signs and other safety requirements prior to opening up sections of work to traffic.

**70-14 Contractor's responsibility for work**. Until the RPR's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with Section 50, paragraph 50-14, *Partial Acceptance*, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at their own expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding furnished under the contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

**70-15 Contractor's responsibility for utility service and facilities of others**. As provided in paragraph 70-04, *Restoration of Surfaces Disturbed by Others*, the Contractor shall cooperate with the owner of any public or private utility service, FAA or NOAA, or a utility service of another government agency that may be authorized by the Owner to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control their operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the contract work, the approximate locations have been indicated on the plans and/or in the contract documents.

It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of the responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the Owners of all utility services or other facilities of their plan of operations. Such notification shall be in writing addressed to "The Person to Contact" as provided in this paragraph and paragraph 70-04, *Restoration of Surfaces Disturbed By Others*. A copy of each notification shall be given to the RPR.

In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep such individual Owners advised of changes in their plan of operations that would affect such Owners.

Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner of their plan of operation. If, in the Contractor's opinion, the Owner's assistance is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner's "Person to Contact" no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the RPR.

The Contractor's failure to give the two days' notice shall be cause for the Owner to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use hand excavation methods within 3 feet (1 m) of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, the Contractor shall immediately notify the proper authority and the RPR and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the RPR continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to their operations whether due to negligence or accident. The Owner reserves the right to deduct such costs from any monies due or which may become due the Contractor, or their own surety.

**70-15.1 FAA facilities and cable runs**. The Contractor is hereby advised that the construction limits of the project include existing facilities and buried cable runs that are owned, operated and maintained by the FAA. The Contractor, during the execution of the project work, shall comply with the following:

**a.** The Contractor shall permit FAA maintenance personnel the right of access to the project work site for purposes of inspecting and maintaining all existing FAA owned facilities.

**b.** The Contractor shall provide notice to the FAA Air Traffic Organization (ATO)/Technical Operations/System Support Center (SSC) Point-of-Contact through the airport Owner a minimum of seven (7) calendar days prior to commencement of construction activities in order to permit sufficient time to locate and mark existing buried cables and to schedule any required facility outages.

**c.** If execution of the project work requires a facility outage, the Contractor shall contact the FAA Point-of-Contact a minimum of 72 hours prior to the time of the required outage.

**d.** Any damage to FAA cables, access roads, or FAA facilities during construction caused by the Contractor's equipment or personnel whether by negligence or accident will require the Contractor to repair or replace the damaged cables, access road, or FAA facilities to FAA requirements. The Contractor shall not bear the cost to repair damage to underground facilities or utilities improperly located by the FAA.

***Any displaced or relocated FAA facility or cables due to construction will require a signed and executed reimbursable agreement between the Owner and the FAA Tech Ops Division.***

***The splicing of cables is not to be an acceptable form of repair for certain projects. If any FAA cables are damaged, the Contractor shall replace the cables in their entirety.***

**e.** If the project work requires the cutting or splicing of FAA owned cables, the FAA Point-of-Contact shall be contacted a minimum of 72 hours prior to the time the cable work commences. The FAA reserves the right to have a FAA representative on site to observe the splicing of the cables as a condition of acceptance. All cable splices are to be accomplished in accordance with FAA specifications and require approval by the FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that FAA restricts the location of where splices may be installed. If a cable splice is required in a location that is not permitted by FAA, the Contractor shall furnish and install a sufficient length of new cable that eliminates the need for any splice.

**70-16 Furnishing rights-of-way**. The Owner will be responsible for furnishing all rights-of-way upon which the work is to be constructed in advance of the Contractor's operations.

**70-17 Personal liability of public officials**. In carrying out any of the contract provisions or in exercising any power or authority granted by this contract, there shall be no liability upon the Engineer, RPR, their authorized representatives, or any officials of the Owner either personally or as an official of the Owner. It is understood that in such matters they act solely as agents and representatives of the Owner.

**70-18 No waiver of legal rights**. Upon completion of the work, the Owner will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Owner be precluded or stopped from recovering from the Contractor or their surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill their obligations under the contract. A waiver on the part of the Owner of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract, shall be liable to the Owner for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under any warranty or guaranty.

**70-19 Environmental protection**. The Contractor shall comply with all federal, state, and local laws and regulations controlling pollution of the environment. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, asphalts, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

***In the event of conflict between Federal, State or local laws, codes, ordinances, rules and regulations concerning pollution control, the most restrictive applicable ones shall apply.***

***The Contractor shall pay special attention to the pollution control requirements of the several specifications. Work items, which may cause excessive pollution and shall be closely controlled by the Contractor, are:***

***a) Clearing, grubbing, burning or other disposal.***

***b) Stripping, excavation, and embankment.***

***c) Drainage and ditching.***

***d) Aggregate production, handling and placing.***

***e) Cement, lime or other stabilization.***

***f) Concrete and bituminous materials handling, production and paving.***

***g) Seeding, fertilizing, mulching and use of herbicides or insecticides.***

***h) Contractor's own housekeeping items; haul routes; sanitary facilities; water supply; equipment fueling; servicing and cleaning; job clean up and disposal.***

***When the Contractor submits his tentative progress schedule in accordance with PROSECUTION and PROGRESS, Section 80, he shall also submit for acceptance of the Owner, his schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing, grading, structures at water courses, construction, and paving, and his proposed methods of erosion control on haul roads and borrow pits and his plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operations have been accepted by the Owner.***

***All bituminous and Portland cement concrete proportioning plants shall meet state requirements.***

***The following listed stipulations shall apply to this Contract unless more restrictive ones are specified by the plans, special provisions, laws, codes, ordinances, etc. Cost of pollution control shall be incidental to the appropriate work items unless otherwise specified.***

1. ***Control of Water Pollution and Siltation.***

   ***(a) All work of water pollution and siltation control is subject to inspection by the local and/or state governmental enforcing agent.***

***(b) All applicable regulations of fish and wildlife agencies and statutes relating to the prevention and abatement of pollution shall be complied with in the performance of the Contract.***

***(c) Construction operations shall be conducted in such manner as to reduce erosion to the practicable minimum and to prevent damaging siltation of water courses, streams, lakes or reservoirs. The surface area of erodible land, either on or off the airport site, exposed to the elements by clearing, grubbing or grading operations, including gravel pits, waste or disposal areas and haul roads, at any one time, for this Contract, shall be subject to approval of the Owner and the duration of such exposure prior to final trimming and finishing of the areas shall be held to the minimum practical. The Owner shall have full authority to order the suspension of grading and other operations pending adequate and proper performance of finishing and maintenance work or to restrict the trimming of erodible land exposed to the elements.***

***(d) Materials used for permanent erosion control measures shall meet the requirements of the applicable specifications. Gravel or stone, consisting of durable particles of rock and containing only negligible quantities of fines, shall be used for construction pads, haul roads and temporary roads in or across streams.***

***(e) Where called for on the plans, a stilling basin shall be constructed to prevent siltation in the stream from construction operations.***

***(f) The disturbance of lands and waters that are outside the limits of construction as staked is prohibited, except as found necessary and approved by the Owner.***

***(g) The Contractor shall conduct his work in such manner as to prevent the entry of fuels, oils, bituminous materials, chemicals, sewage or other harmful materials into streams, rivers, lakes or reservoirs.***

***(h) Water from aggregate washing or other operations containing sediment shall be treated by filtration, by use of a settling basin or other means to reduce the sediment content to a level acceptable to the local and/or state governmental enforcing agent.***

***(i) All waterways shall be cleared as soon as practicable of falsework, piling, debris or other obstructions placed during construction operations and not a part of the finished work. Care shall be taken during construction and removal of such barriers to minimize the muddying of a stream.***

***(j) The Contractor shall care for the temporary erosion and siltation control measures during the period that the temporary measures are required and for the permanent erosion control measures until the Contract has been completed and accepted. Such care shall consist of the repair of areas damaged be erosion, wind, fire or other causes.***

***(k) Permanent and temporary erosion control work that is damaged due to the Contractor's operations or where the work required is attributed to the Contractor's negligence, carelessness or failure to install permanent controls at the proper time, shall be repaired at the Contractor's expense.***

***2. Control of Other Air Pollutants.***

***(a) Grading areas shall be kept at proper moisture conditions.***

***(b) Sand or dust blows shall be temporarily mulched with or without seeding, or otherwise controlled with stabilizing agents.***

***(c) Temporary roads, haul roads, traffic or work areas shall be stabilized with dust palliative, penetration asphalt, woodchips, or other approved measures to prevent dust pollution.***

***(d) Cements, fertilizers, chemicals, volatiles, etc. shall be stored in properly containers or with proper coverings to prevent accidental discharge into the air.***

***(e) Aggregate bins, cement bins, and dry material batch trucks shall be properly covered to prevent loss of material to the air.***

***(f) Drilling, grinding and sand blasting apparatus shall be equipped with water, chemical, or vacuum dust controlling systems.***

***(g) Applications of chemicals and bitumens shall be held to recommended rates.***

***(h) Bituminous mixing plants shall be equipped with dust collectors as noted in the specifications.***

***(i) Quarrying, batching, and mixing operations and the transfer of materials between trucks, bins, or stockpiles shall be properly controlled to minimize dust diffusion.***

***(j) When necessary, certain operations shall be delayed until proper wind or climatic conditions exist to dissipate or inhibit potential pollutants to the satisfaction of the Owner.***

**70-20 Archaeological and historical findings**. Unless otherwise specified in this subsection, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

Should the Contractor encounter, during their operations, any building, part of a building, structure, or object that is incongruous with its surroundings, the Contractor shall immediately cease operations in that location and notify the RPR. The RPR will immediately investigate the Contractor's finding and the Owner will direct the Contractor to either resume operations or to suspend operations as directed.

Should the Owner order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate contract change order or supplemental agreement as provided in Section 40, paragraph 40-04, *Extra Work,* and Section 90, paragraph 90-05, *Payment for Extra Work*. If appropriate, the contract change order or supplemental agreement shall include an extension of contract time in accordance with Section 80, paragraph 80-07, *Determination and Extension of Contract Time*.

**70-21 Insurance Requirements.** ***Refer to the ITB for insurance requirements.***

## END OF SECTION 70

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# SECTION 80 EXECUTION AND PROGRESS

**80-01 Subletting of contract**. The Owner will not recognize any subcontractor on the work. The Contractor shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Resident Project Representative (RPR).

The Contractor shall perform, with his organization, an amount of work equal to at least **35** percent of the total contract cost.

Should the Contractor elect to assign their contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the Owner, and shall be consummated only on the written approval of the Owner.

**The Contractor shall provide copies of all subcontracts to the RPR 14 days prior to being utilized on the project. As a minimum, the information shall include the following:**

- Subcontractor's legal company name.
- Subcontractor's legal company address, including County name.
- Principal contact person's name, telephone and fax number.
- Complete narrative description, and dollar value of the work to be performed by the subcontractor.
- Copies of required insurance certificates in accordance with the specifications.
- Minority/ non-minority status.

**80-02 Notice to proceed (NTP)**. The Owners notice to proceed will state the date on which contract time commences. The Contractor is expected to commence project operations within **14** days of the NTP date. The Contractor shall notify the RPR at least **24** hours in advance of the time contract operations begins. The Contractor shall not commence any actual operations prior to the date on which the notice to proceed is issued by the Owner.

**80-03 Execution and progress**. Unless otherwise specified, the Contractor shall submit their coordinated construction schedule showing all work activities for the RPR's review and acceptance at least **10** days prior to the start of work. The Contractor's progress schedule, once accepted by the RPR, will represent the Contractor's baseline plan to accomplish the project in accordance with the terms and conditions of the Contract. The RPR will compare actual Contractor progress against the baseline schedule to determine that status of the Contractor's performance. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the RPR's request, submit a revised schedule for completion of the work within the contract time and modify their operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the execution of the work be discontinued for any reason, the Contractor shall notify the RPR at least **24** hours in advance of resuming operations.

The Contractor shall not commence any actual construction prior to the date on which the NTP is issued by the Owner.

The project schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or other format, or as otherwise specified. It shall include information on the sequence of work activities, milestone dates, and activity duration. The schedule shall show all work items identified in the project proposal for each work area and shall include the project start date and end date.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a **twice** monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

**80-04 Limitation of operations**. The Contractor shall control their operations and the operations of their subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

When the work requires the Contractor to conduct their operations within an AOA of the airport, the work shall be coordinated with airport operations (through the RPR) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the RPR and until the necessary temporary marking, signage and associated lighting is in place as provided in Section 70, paragraph 70-08, *Construction Safety and Phasing Plan (CSPP)*.

When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; and immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until satisfactory conditions are provided. The areas of the AOA identified in the Construction Safety Phasing Plan (CSPP) and as listed below, cannot be closed to operating aircraft to permit the Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently as ***indicated on the plans***. ~~follows:~~

The Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction and the approved CSPP.

**80-04.1 Operational safety on airport during construction.** All Contractors' operations shall be conducted in accordance with the approved project Construction Safety and Phasing Plan (CSPP) and the Safety Plan Compliance Document (SPCD) and the provisions set forth within the current version of AC 150/5370-2, Operational Safety on Airports During Construction. The CSPP included within the contract documents conveys minimum requirements for operational safety on the airport during construction activities. The Contractor shall prepare and submit a SPCD that details how it proposes to comply with the requirements presented within the CSPP.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and SPCD ***AC 150/5370-2*** and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved CSPP and SPCD unless approved in writing by the Owner. The necessary coordination actions to review Contractor proposed modifications to an approved CSPP or approved SPCD can require a significant amount of time.

**80-05 Character of workers, methods, and equipment**. The Contractor shall, at all times, employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Any person employed by the Contractor or by any subcontractor who violates any operational regulations or operational safety requirements and, in the opinion of the RPR, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the RPR, be removed immediately by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without approval of the RPR.

Should the Contractor fail to remove such person or persons, or fail to furnish suitable and sufficient personnel for the proper execution of the work, the RPR may suspend the work by written notice until compliance with such orders.

All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall not cause injury to previously completed work, adjacent property, or existing airport facilities due to its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the contract, the Contractor is free to use any methods or equipment that will accomplish the work in conformity with the requirements of the contract, plans, and specifications.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless otherwise authorized by the RPR. If the Contractor desires to use a method or type of equipment other than specified in the contract, the Contractor may request authority from the RPR to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the RPR determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or take such other corrective action as the RPR may direct. No change will be made in basis of payment for the contract items involved nor in contract time as a result of authorizing a change in methods or equipment under this paragraph.

**80-06 Temporary suspension of the work**. The Owner shall have the authority to suspend the work wholly, or in part, for such period or periods the Owner may deem necessary, due to unsuitable weather, or other conditions considered unfavorable for the execution of the work, or for such time necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

In the event that the Contractor is ordered by the Owner, in writing, to suspend work for some unforeseen cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the written order to suspend work to the effective date of the written order to resume the work. Claims for such compensation shall be filed with the RPR within the time period stated in the RPR's order to resume work. The Contractor shall submit with their own claim information substantiating the amount shown on the claim. The RPR will forward the Contractor's claim to the Owner for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather or for any other delay provided for in the contract, plans, or specifications.

If it becomes necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. The Contractor shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the airport.

**80-07 Determination and extension of contract time**. The number of calendar days shall be stated in the proposal and contract and shall be known as the Contract Time.

If the contract time requires extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

**80-07.1 Contract time based on working days.** Contract time based on calendar days shall consist of the number of calendar days stated in the contract counting from the effective date of the Notice to Proceed and including all Saturdays, Sundays, holidays, and non-work days. All calendar days elapsing between the effective dates of the Owner's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall be excluded.

At the time of final payment, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in the contract time shall not consider either cost of work or the extension of contract time that has been covered by a change order or supplemental agreement. Charges against the contract time will cease as of the date of final acceptance.

**80-08 Failure to complete on time**. For each calendar day or working day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in paragraph 80-07, *Determination and Extension of Contract Time*) the sum specified in the contract and proposal as liquidated damages (LD) will be deducted from any money due or to become due the Contractor or their own surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion

of damages including but not limited to additional engineering services that will be incurred by the Owner should the Contractor fail to complete the work in the time provided in their contract.

The maximum construction time allowed for ~~Schedules~~ ***the entire project*** will be the sum of the time allowed for individual schedules but not more than **224** days ***the total contract time specified in the contract documents***. Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a wavier on the part of the Owner of any of its rights under the contract. ***Liquidated damages will be assessed as provided in the bid submittal form.***

**80-09 Default and termination of contract**. The Contractor shall be considered in default of their contract and such default will be considered as cause for the Owner to terminate the contract for any of the following reasons, if the Contractor:

**a.** Fails to begin the work under the contract within the time specified in the Notice to Proceed, or

**b.** Fails to perform the work or fails to provide sufficient workers, equipment and/or materials to assure completion of work in accordance with the terms of the contract, or

**c.** Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

**d.** Discontinues the execution of the work, or

**e.** Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

**f.** Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

**g.** Allows any final judgment to stand against the Contractor unsatisfied for a period of 10 days, or

**h.** Makes an assignment for the benefit of creditors, or

**i.** For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Owner consider the Contractor in default of the contract for any reason above, the Owner shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the contract.

If the Contractor or surety, within a period of **10** days after such notice, does not proceed in accordance therewith, then the Owner will, upon written notification from the RPR of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the execution of the work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the RPR will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Owner the amount of such excess.

**80-10 Termination for national emergencies**. The Owner shall terminate the contract or portion thereof by written notice when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the execution of war or in the interest of national defense.

When the contract, or any portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the actual number of units or items of work completed at the contract price or as mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits shall be considered.

Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in the contract) and moving equipment and materials to and from the job will be considered, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the RPR.

Termination of the contract or a portion thereof shall neither relieve the Contractor of their responsibilities for the completed work nor shall it relieve their surety of its obligation for and concerning any just claim arising out of the work performed.

**80-11 Work area, storage area and sequence of operations**. The Contractor shall obtain approval from the RPR prior to beginning any work in all areas of the airport. No operating runway, taxiway, or air operations area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor shall plan and coordinate work in accordance with the approved CSPP and SPCD.

## END OF SECTION 80

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# SECTION 90 MEASUREMENT AND PAYMENT

**90-01 Measurement of quantities**. All work completed under the contract will be measured by the RPR, or their authorized representatives, using United States Customary Units of Measurement.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet (0.8 square meters) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the RPR.

Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

When requested by the Contractor and approved by the RPR in writing, material specified to be measured by the cubic yard (cubic meter) may be weighed, and such weights will be converted to cubic yards (cubic meters) for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the RPR and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

**Measurement and Payment Terms**

| Term | Description |
|---|---|
| **Excavation and Embankment Volume** | In computing volumes of excavation, the average end area method will be used unless otherwise specified. |
| **Measurement and Proportion by Weight** | The term "ton" will mean the short ton consisting of 2,000 pounds (907 km) avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, independently certified scales by competent, qualified personnel at locations designated by the RPR. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the RPR directs, and each truck shall bear a plainly legible identification mark. |
| **Measurement by Volume** | Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable for the materials hauled, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery. |
| **Asphalt Material** | Asphalt materials will be measured by ~~the gallon (liter) or~~ ton (kg). ~~When measured by volume, such volumes will be measured at 60°F (16°C) or will be corrected to the volume at 60°F (16°C) using ASTM D1250 for asphalts.~~ Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when asphalt material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work. When asphalt materials are shipped by truck or transport, net certified weights by volume, subject to |

| Term | Description |
|---|---|
| | correction for loss or foaming, will be used for computing quantities. |
| **Cement** | Cement will be measured by the ton (kg) or hundredweight (km). |
| **Structure** | Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions. |
| **Timber** | Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece. |
| **Plates and Sheets** | The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inch. |
| **Miscellaneous Items** | When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted. |
| **Scales** | Scales must be tested for accuracy and serviced before use. Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.<br><br>Scales shall be accurate within 0.5% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the RPR before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed 0.1% of the nominal rated capacity of the scale, but not less than one pound (454 grams). The use of spring balances will not be permitted.<br><br>In the event inspection reveals the scales have been “overweighing” (indicating more than correct weight) they will be immediately adjusted. All materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of 0.5%.<br><br>In the event inspection reveals the scales have been under-weighing (indicating less than correct weight), they shall be immediately adjusted. No additional payment to the Contractor will be allowed for materials previously weighed and recorded.<br><br>Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the RPR can safely and conveniently view them.<br><br>Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment.<br><br>All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project. |
| **Rental Equipment** | Rental of equipment will be measured by time in hours of actual working time and |

| Term | Description |
|---|---|
| | necessary traveling time of the equipment within the limits of the work. Special equipment ordered in connection with extra work will be measured as agreed in the change order or supplemental agreement authorizing such work as provided in paragraph 90-05 *Payment for Extra Work*. |
| **Pay Quantities** | When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the RPR. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions. |

**90-02 Scope of payment**. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, for performing all work under the contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the execution thereof, subject to the provisions of Section 70, paragraph 70-18, *No Waiver of Legal Rights*.

When the "basis of payment" subsection of a technical specification requires that the contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or specifications.

**90-03 Compensation for altered quantities**. When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in Section 40, paragraph 40-02, *Alteration of Work and Quantities,* will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from their own unbalanced allocation of overhead and profit among the contract items, or from any other cause.

**90-04 Payment for omitted items**. As specified in Section 40, paragraph 40-03, *Omitted Items,* the RPR shall have the right to omit from the work (order nonperformance) any contract item, except major contract items, in the best interest of the Owner.

Should the RPR omit or order nonperformance of a contract item or portion of such item from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed and acceptable prior to the RPR's order to omit or non-perform such contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the RPR's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the Owner.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted contract item prior to the date of the RPR's order. Such additional costs incurred by the Contractor must be directly related to the deleted contract item and shall be supported by certified statements by the Contractor as to the nature the amount of such costs.

**90-05 Payment for extra work**. Extra work, performed in accordance with Section 40, paragraph 40-04, *Extra Work*, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work.

**90-06 Partial payments**. Partial payments will be made to the Contractor at least once each month as the work progresses. Said payments will be based upon estimates, prepared by the RPR, of the value of the work performed and materials complete and in place, in accordance with the contract, plans, and specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with paragraph 90-07, *Payment for Materials on Hand*. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

From the total of the amount determined to be payable on a partial payment, 10 percent of such total amount will be deducted and retained by the Owner for protection of the Owner's interests. Unless otherwise instructed by the Owner, the amount retained by the Owner will be in effect until the final payment is made except as follows:

(1) Contractor may request release of retainage on work that has been partially accepted by the Owner in accordance with Section 50-03. Contractor must provide a certified invoice to the RPR that supports the value of retainage held by the Owner for partially accepted work.

~~(2) In lieu of retainage, the Contractor may exercise at its option the establishment of an escrow account per paragraph 90-08.~~

b. The Contractor is required to pay all subcontractors for satisfactory performance of their contracts no later than 30 days after the Contractor has received a partial payment. Contractor must provide the Owner evidence of prompt and full payment of retainage held by the prime Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed. A subcontractor's work is satisfactorily completed when all the tasks called for in the subcontract have been accomplished and documented as required by the Owner. When the Owner has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

c. When at least 95% of the work has been completed to the satisfaction of the RPR, the RPR shall, at the Owner's discretion and with the consent of the surety, prepare estimates of both the contract value and the cost of the remaining work to be done. The Owner may retain an amount not less than twice the contract value or estimated cost, whichever is greater, of the work remaining to be done. The remainder, less all previous payments and deductions, will then be certified for payment to the Contractor.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the RPR to be a part of the final quantity for the item of work in question.

No partial payment shall bind the Owner to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in paragraph 90-09, *Acceptance and Final Payment*.

The Contractor shall deliver to the Owner a complete release of all claims for labor and material arising out of this contract before the final payment is made. If any subcontractor or supplier fails to furnish such a release in full, the Contractor may furnish a bond or other collateral satisfactory to the Owner to indemnify the Owner against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and attorney fees the Owner may be compelled to pay in discharging any such lien or claim.

**90-07 Payment for materials on hand.** Partial payments may be made to the extent of the delivered cost of materials to be incorporated in the work, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the Owner. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

**a.** The material has been stored or stockpiled in a manner acceptable to the RPR at or on an approved site.

**b.** The Contractor has furnished the RPR with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

**c.** The Contractor has furnished the RPR with satisfactory evidence that the material and transportation costs have been paid.

**d.** The Contractor has furnished the Owner legal title (free of liens or encumbrances of any kind) to the material stored or stockpiled.

**e.** The Contractor has furnished the Owner evidence that the material stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time prior to use in the work.

It is understood and agreed that the transfer of title and the Owner's payment for such stored or stockpiled materials shall in no way relieve the Contractor of their responsibility for furnishing and placing such materials in accordance with the requirements of the contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this paragraph.

**90-08 Payment of withheld funds**. At the Contractor's option, if an Owner withholds retainage in accordance with the methods described in paragraph 90-06 *Partial Payments*, the Contractor may request that the Owner deposit the retainage into an escrow account. The Owner's deposit of retainage into an escrow account is subject to the following conditions:

**a.** The Contractor shall bear all expenses of establishing and maintaining an escrow account and escrow agreement acceptable to the Owner.

**b.** The Contractor shall deposit to and maintain in such escrow only those securities or bank certificates of deposit as are acceptable to the Owner and having a value not less than the retainage that would otherwise be withheld from partial payment.

**c.** The Contractor shall enter into an escrow agreement satisfactory to the Owner.

**d.** The Contractor shall obtain the written consent of the surety to such agreement.

**90-09 Acceptance and final payment**. When the contract work has been accepted in accordance with the requirements of Section 50, paragraph 50-15, *Final Acceptance*, the RPR will prepare the final estimate of the items of work actually performed. The Contractor shall approve the RPR's final estimate or advise the RPR of the Contractor's objections to the final estimate which are based on disputes in measurements or computations of the final quantities to be paid under the contract as amended by change order or supplemental agreement. The Contractor and the RPR shall resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the RPR's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the RPR's estimate under protest of the quantities in dispute, and such disputed quantities shall be considered by the Owner as a claim in accordance with Section 50, paragraph 50-16, *Claims for Adjustment and Disputes*.

After the Contractor has approved, or approved under protest, the RPR's final estimate, and after the RPR's receipt of the project closeout documentation required in paragraph 90-11, *Contractor Final Project Documentation*, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

If the Contractor has filed a claim for additional compensation under the provisions of Section 50, paragraph 50-16, *Claims for Adjustments and Disputes,* or under the provisions of this paragraph, such claims will be considered by the Owner in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

**90-10 Construction warranty.**

**a.** In addition to any other warranties in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

**b.** This warranty shall continue for a period of one year from the date of final acceptance of the work, except as noted. If the Owner takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one year from the date the Owner takes possession. However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work. ~~Light Emitting Diode emitting diode (LED) light fixtures with the exception of obstruction lighting, must be warranted by the manufacturer for a minimum of four (4) years after date of installation inclusive of all electronics.~~

**c.** The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that

damage is the result of the Contractor's failure to conform to contract requirements; or any defect of equipment, material, workmanship, or design furnished by the Contractor.

**d.** The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one year from the date of repair or replacement.

**e.** The Owner will notify the Contractor, in writing, within seven **(7)** days after the discovery of any failure, defect, or damage.

**f.** If the Contractor fails to remedy any failure, defect, or damage within **14** days after receipt of notice, the Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

**g.** With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the benefit of the Owner, as directed by the Owner, and (3) Enforce all warranties for the benefit of the Owner.

**h.** This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

**90-11 Contractor Final Project Documentation.** Approval of final payment to the Contractor is contingent upon completion and submittal of the items listed below. The final payment will not be approved until the RPR approves the Contractor's final submittal. The Contractor shall:

**a.** Provide two (2) copies of all manufacturers warranties specified for materials, equipment, and installations.

**b.** Provide weekly payroll records (not previously received) from the general Contractor and all subcontractors.

**c.** Complete final cleanup in accordance with Section 40, paragraph 40-08, *Final Cleanup*.

**d.** Complete all punch list items identified during the Final Inspection.

**e.** Provide complete release of all claims for labor and material arising out of the Contract.

**f.** Provide a certified statement signed by the subcontractors, indicating actual amounts paid to the Disadvantaged Business Enterprise (DBE) subcontractors and/or suppliers associated with the project.

**g.** When applicable per state requirements, return copies of sales tax completion forms.

**h.** Manufacturer's certifications for all items incorporated in the work.

**i.** All required record drawings, as-built drawings or as-constructed drawings.

**j.** Project Operation and Maintenance (O&M) Manual(s).

k. Security for Construction Warranty.

**l.** Equipment commissioning documentation submitted, if required.

## END OF SECTION 90

# TECHNICAL SPECIFICATIONS

# ITEM C-100 CONTRACTOR QUALITY CONTROL PROGRAM (CQCP)

**100-1 General.** Quality is more than test results. Quality is the combination of proper materials, testing, workmanship, equipment, inspection, and documentation of the project. Establishing and maintaining a culture of quality is key to achieving a quality project. The Contractor shall establish, provide, and maintain an effective Contractor Quality Control Program (CQCP) that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The Contractor shall establish a CQCP that will:

**a.** Provide qualified personnel to develop and implement the CQCP.

**b.** Provide for the production of acceptable quality materials.

**c.** Provide sufficient information to assure that the specification requirements can be met.

**d.** Document the CQCP process.

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the CQCP has been reviewed and approved by the Resident Project Representative (RPR). No partial payment will be made for materials subject to specific quality control (QC) requirements until the CQCP has been reviewed and approved.

The QC requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the quality assurance (QA) testing requirements. QA testing requirements are the responsibility of the RPR or Contractor as specified in the specifications.

A Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Resident Project Representative (RPR), Contractor, subcontractors, testing laboratories, and Owner's representative must be held prior to start of construction. The QC/QA workshop will be facilitated by the Contractor. The Contractor shall coordinate with the Airport and the RPR on time and location of the QC/QA workshop. Items to be addressed, at a minimum, will include:

**a.** Review of the CQCP including submittals, QC Testing, Action & Suspension Limits for Production, Corrective Action Plans, Distribution of QC reports, and Control Charts.

**b.** Discussion of the QA program.

**c.** Discussion of the QC and QA Organization and authority including coordination and information exchange between QC and QA.

**d.** Establish regular meetings to discuss control of materials, methods and testing.

**e.** Establishment of the overall QC culture.

**100-2 Description of program.**

**a. General description.** The Contractor shall establish a CQCP to perform QC inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. The CQCP shall ensure conformance to applicable specifications and plans with respect to materials, off-site fabrication, workmanship, construction, finish, and functional performance. The CQCP shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of QC.

**b. Contractor Quality Control Program (CQCP).** The Contractor shall describe the CQCP in a written document that shall be reviewed and approved by the RPR prior to the start of any production, construction, or off-site fabrication. The written CQCP shall be submitted to the RPR for review and approval at least **10** calendar days before the CQCP Workshop. The Contractor's CQCP and QC testing laboratory must be approved in writing by the RPR prior to the Notice to Proceed (NTP).

The CQCP shall be organized to address, as a minimum, the following:

1. QC organization and resumes of key staff
2. Project progress schedule
3. Submittals schedule
4. Inspection requirements
5. QC testing plan
6. Documentation of QC activities and distribution of QC reports
7. Requirements for corrective action when QC and/or QA acceptance criteria are not met
8. Material quality and construction means and methods. Address all elements applicable to the project that affect the quality of the pavement structure including subgrade, subbase, base, and surface course. Some elements that must be addressed include, but is not limited to mix design, aggregate grading, stockpile management, mixing and transporting, placing and finishing, quality control testing and inspection, smoothness, laydown plan, equipment, and temperature management plan.

The Contractor must add any additional elements to the CQCP that is necessary to adequately control all production and/or construction processes required by this contract.

**100-3 CQCP organization.** The CQCP shall be implemented by the establishment of a QC organization. An organizational chart shall be developed to show all QC personnel, their authority, and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all QC staff by name and function, and shall indicate the total staff required to implement all elements of the CQCP, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the CQCP, the personnel assigned shall be subject to the qualification requirements of paragraphs 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The QC organization shall, as a minimum, consist of the following personnel:

**a. Program Administrator.** The Contractor Quality Control Program Administrator (CQCPA) must be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The CQCPA must have a minimum of five (5) years of experience in QC pavement construction with prior QC experience on a project of comparable size and scope as the contract.

Included in the five (5) years of paving/QC experience, the CQCPA must meet at least one of the following requirements:

**(1)** Professional Engineer with one (1) year of airport paving experience.

**(2)** Engineer-in-training with two (2) years of airport paving experience.

**(3)** National Institute for Certification in Engineering Technologies (NICET) Civil Engineering Technology Level IV with three (3) years of airport paving experience.

**(4)** An individual with four (4) years of airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

The CQCPA must have full authority to institute any and all actions necessary for the successful implementation of the CQCP to ensure compliance with the contract plans and technical specifications. The CQCPA authority must include the ability to immediately stop production until materials and/or processes are in compliance with contract specifications. The CQCPA must report directly to a principal officer of the construction firm. The CQCPA may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

**b. QC technicians.** A sufficient number of QC technicians necessary to adequately implement the CQCP must be provided. These personnel must be either Engineers, engineering technicians, or experienced craftsman with

qualifications in the appropriate field equivalent to NICET Level II in Civil Engineering Technology or higher, and shall have a minimum of two (2) years of experience in their area of expertise.

The QC technicians must report directly to the CQCPA and shall perform the following functions:

**(1)** Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by paragraph 100-6.

**(2)** Performance of all QC tests as required by the technical specifications and paragraph100-8.

**(3)** Performance of tests for the RPR when required by the technical specifications.

Certification at an equivalent level of qualification and experience by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

**c. Staffing levels.** The Contractor shall provide sufficient qualified QC personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The CQCP shall state where different technicians will be required for different work elements.

**100-4 Project progress schedule.** Critical QC activities must be shown on the project schedule as required by Section 80, paragraph 80-03, *Execution and Progress*.

**100-5 Submittals schedule.** The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include as a minimum:

**a.** Specification item number

**b.** Item description

**c.** Description of submittal

**d.** Specification paragraph requiring submittal

**e.** Scheduled date of submittal

**100-6 Inspection requirements.** QC inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by paragraph 100-9.

Inspections shall be performed as needed to ensure continuing compliance with contract requirements until completion of the particular feature of work. Inspections shall include the following minimum requirements:

**a.** During plant operation for material production, QC test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The CQCP shall detail how these and other QC functions will be accomplished and used.

**b.** During field operations, QC test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The CQCP shall document how these and other QC functions will be accomplished and used.

**100-7 Contractor QC testing facility.**

**a.** For projects that include Item P-401, Item P-403, and Item P-404, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM D3666, *Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials*:

- 8.1.3 Equipment Calibration and Checks;
- 8.1.9 Equipment Calibration, Standardization, and Check Records;

- 8.1.12 Test Methods and Procedures

**b.** For projects that include P-501, the Contractor shall ensure facilities, including all necessary equipment, materials, and current reference standards, are provided that meet requirements in the following paragraphs of ASTM C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation:

- 7 Test Methods and Procedures
- 8 Facilities, Equipment, and Supplemental Procedures

**100-8 QC testing plan.** As a part of the overall CQCP, the Contractor shall implement a QC testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional QC tests that the Contractor deems necessary to adequately control production and/or construction processes.

The QC testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

**a.** Specification item number (e.g., P-401)

**b.** Item description (e.g., Hot Mix Asphalt Pavements)

**c.** Test type (e.g., gradation, grade, asphalt content)

**d.** Test standard (e.g., ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)

**e.** Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated)

**f.** Responsibility (e.g., plant technician)

**g.** Control requirements (e.g., target, permissible deviations)

The QC testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The RPR shall be provided the opportunity to witness QC sampling and testing.

All QC test results shall be documented by the Contractor as required by paragraph 100-9.

**100-9 Documentation.** The Contractor shall maintain current QC records of all inspections and tests performed. These records shall include factual evidence that the required QC inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the RPR daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the CQCPA.

Contractor QC records required for the contract shall include, but are not necessarily limited to, the following records:

**a. Daily inspection reports.** Each Contractor QC technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous QC inspections have been performed and shall, as a minimum, include the following:

**(1)** Technical specification item number and description

**(2)** Compliance with approved submittals

**(3)** Proper storage of materials and equipment

**(4)** Proper operation of all equipment

**(5)** Adherence to plans and technical specifications

**(6)** Summary of any necessary corrective actions

**(7)** Safety inspection.

**(8)** Photographs and/or video

The daily inspection reports shall identify all QC inspections and QC tests conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible QC technician and the CQCPA. The RPR shall be provided at least one copy of each daily inspection report on the work day following the day of record. When QC inspection and test results are recorded and transmitted electronically, the results must be archived.

**b. Daily test reports.** The Contractor shall be responsible for establishing a system that will record all QC test results. Daily test reports shall document the following information:

(1) Technical specification item number and description
(2) Test designation
(3) Location
(4) Date of test
(5) Control requirements
(6) Test results
(7) Causes for rejection
(8) Recommended remedial actions
(9) Retests

Test results from each day's work period shall be submitted to the RPR prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical QC charts. When QC daily test results are recorded and transmitted electronically, the results must be archived.

**100-10 Corrective action requirements.** The CQCP shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the CQCP as a whole, and for individual items of work contained in the technical specifications.

The CQCP shall detail how the results of QC inspections and tests will be used for determining the need for corrective action and shall contain clear rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical QC charts for individual QC tests. The requirements for corrective action shall be linked to the control charts.

**100-11 Inspection and/or observations by the RPR.** All items of material and equipment are subject to inspection and/or observation by the RPR at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate QC system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to inspection and/or observation by the RPR at the site for the same purpose.

Inspection and/or observations by the RPR does not relieve the Contractor of performing QC inspections of either on-site or off-site Contractor's or subcontractor's work.

**100-12 Noncompliance.**

**a.** The Resident Project Representative (RPR) will provide written notice to the Contractor of any noncompliance with their CQCP. After receipt of such notice, the Contractor must take corrective action.

**b.** When QC activities do not comply with either the CQCP or the contract provisions or when the Contractor fails to properly operate and maintain an effective CQCP, and no effective corrective actions have been taken after notification of non-compliance, the RPR will recommend the Owner take the following actions:

**(1)** Order the Contractor to replace ineffective or unqualified QC personnel or subcontractors and/or

**(2)** Order the Contractor to stop operations until appropriate corrective actions are taken.

## METHOD OF MEASUREMENT

**100-13 Basis of measurement and payment.** Contractor Quality Control Program (CQCP) is for the personnel, tests, facilities and documentation required to implement the CQCP. ~~The CQCP will be paid as a lump sum with the following schedule of partial payments:~~ ***No separate payment will be made for this item.***

## BASIS OF PAYMENT

**100-14 Payment will be made under:**

***No separate payment will be made for this item.***

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

National Institute for Certification in Engineering Technologies (NICET)

ASTM International (ASTM)

| | |
|---|---|
| ASTM C1077 | Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation |
| ASTM D3665 | Standard Practice for Random Sampling of Construction Materials |
| ASTM D3666 | Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials |

## END OF ITEM C-100

# ITEM P-200 FDOT STANDARD INDEX AND SPECIFICATIONS

## PART 1 – GENERAL

### 1.1 FDOT SPECIFICATIONS

**a.** The construction details which will govern the prosecution of the work as set out in the proposal and/or shown on the plans shall conform in their entirety to Divisions II and III of the Florida Department of Transportation Standard Specifications for Road and Bridge Construction dated 2020 including all FDOT Supplements and as modified hereinafter.

**b.** The construction details contained in the Divisions which are not required to accomplish the work set out in proposal and/or shown on the plans will have no application to these specifications.

**c.** These standard specifications may be obtained from:

Florida Department of Transportation
Map and Publication Sales
Mail Station 12, Room Number 27
605 Suwannee Street
Tallahassee, Florida, 32399-0450
(904) 488-9220.

**Specifications are available online at:**

http://www.fdot.gov/programmanagement/Implemented/SpecBooks/

**d.** A copy is on file and may be inspected at the Office of the Engineer. The Contractor shall have at least one set of the standard specifications available on the project.

**e.** Specifications pertinent to this project from the Standard Specifications for Road and Bridge Construction are as follows:

| *FDOT Section* | *Description* |
|---|---|
| | |
| GENERAL CONSTRUCTION OPERATIONS | |
| 101 | Mobilization |
| 102 | Maintenance of Traffic |
| PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLUTION | |
| 104 | Prevention, Control, and Abatement of Erosion and Water Pollution |
| CLEARING CONSTRUCTION SITE | |
| 110 | Clearing and Grubbing |
| EARTHWORK AND RELATED OPERATIONS | |
| 120 | Excavation and Embankment |
| 160 | Stabilizing |
| BASE COURSES | |
| 230 | Limerock Stabilized Base |
| 285 | Optional Base Course |

| *FDOT Section* | *Description* |
|---|---|
| BITUMINOUS TREATMENTS, SURFACE COURSES, AND CONCRETE PAVEMENT | |
| 330 | Hot Mix Asphalt – General Construction Requirements |
| 334 | Superpave Asphalt Concrete |
| 300 | Prime and Tack Coat for Base Courses |
| INCIDENTAL CONSTRUCITON | |
| 570 | Performance Turf |

**f.** Specification sections not specified above but cross-referenced in the above individual sections are also included herewith and made a part of these Contract Documents.

## 1.2 FDOT DESIGN STANDARDS

**a.** Design Standards as referenced shall be the Florida Department of Transportation FY2019-2020 Standard Plans for Road and Bridge Construction.

**b.** These standard specifications may be obtained from:

Florida Department of Transportation
Map and Publication Sales
Mail Station 12, Room Number 27
605 Suwannee Street
Tallahassee, Florida, 32399-0450
(904) 488-9220.

Design Standards are available online at:
https://www.fdot.gov/design/standardplans/SPRBC.shtm

## 1.3 CONFLICT RESOLUTION

**a.** In the event of any conflict(s) between the Contract Documents and the FDOT Standard Specifications, the precedence in resolving such conflict(s) shall be as follows:

**1.** Bidding, Contract Requirements, Contract Drawings and Technical Specifications for this project outlined in the contract documents shall govern over FDOT Bid and Contract Requirements.

**2.** Greater Quantities shall govern over lesser.

**3.** Higher quality and/or more stringent requirements as adjudged by the Engineer shall govern over lesser.

**b.** Where FDOT Specifications refer to the "Engineer", "Engineer of Tests", or "Division of Tests", it shall be understood to mean the Engineer of the Owner as Stated in the CONTRACT.

# PART 2 - EXECUTION

**2.1 MEASUREMENT AND PAYMENT:** Method of measurement and basis of payment for material and work performed in conformance with the above specifications shall be as indicated on the BID SCHEDULE at the unit shown on the bid schedule. The costs bid shall be full compensation for labor, equipment, materials and incidentals necessary to complete the work in conformance with the Plans and Specification to the satisfaction of the Owner. Incidentals include, but are not limited to, items which have specific DOT bid item numbers in the referenced specifications but are not included in the Bid Schedule.

## END OF ITEM FDOT P-200

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# ITEM P-610 CONCRETE FOR MISCELLANEOUS STRUCTURES

## DESCRIPTION

**610-1.1** This item shall consist of concrete and reinforcement, as shown on the plans, prepared and constructed in accordance with these specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

## MATERIALS

**610-2.1 General.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Resident Project Representative (RPR) before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

**a. Reactivity.** Fine aggregate and coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the RPR. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08% at 14 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08% at 14 days, but less than 0.20%, a minimum of 25% of Type F fly ash, or between 40% and 55% of slag cement shall be used in the concrete mix.

If the expansion is greater than 0.20% the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation.

**610-2.2 Coarse aggregate.** The coarse aggregate for concrete shall meet the requirements of ASTM C33 and the requirements of Table 4, Class Designation 5S; and the grading requirements shown below, as required for the project.

**Coarse Aggregate Grading Requirements**

| **Maximum Aggregate Size** | **ASTM C33, Table 3 Grading Requirements (Size No.)** |
|---|---|
| 1 1/2 inch (37.5 mm) | 467 or<br>4 and 67 |
| 1 inch (25 mm) | 57 |
| ¾ inch (19 mm) | 67 |
| ½ inch (12.5 mm) | 7 |

**610-2.2.1 Coarse Aggregate susceptibility to durability (D) cracking.** Not used.

**610-2.3 Fine aggregate.** The fine aggregate for concrete shall meet all fine aggregate requirements of ASTM C33.

**610-2.4 Cement.** Cement shall conform to the requirements of ASTM C150,Type I or II

**610-2.5 Cementitious materials.**

**a. Fly ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 13%and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the RPR.

**b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

**610-2.6 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

**610-2.7 Admixtures.** The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the RPR may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the RPR from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

**a. Air-entraining admixtures**. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

**b. Water-reducing admixtures**. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

**c. Other chemical admixtures**. The use of set retarding, and set-accelerating admixtures shall be approved by the RPR. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

**610-2.8 Premolded joint material.** Premolded joint material for expansion joints shall meet the requirements of ASTM **ASTM D1751.**

**610-2.9 Joint filler.** The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

**610-2.10 Steel reinforcement.** Reinforcing shall consist of ***welded steel wire fabric*** conforming to the requirements of **ASTM A1064.**

**610-2.11 Materials for curing concrete.** Curing materials shall conform to ***one of the following specifications:***

**Materials for Curing**

| | |
|---|---|
| **Waterproof paper** | **ASTM C171** |
| **Clear or white Polyethylene Sheeting** | **ASTM C171** |
| **White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B** | **ASTM C309** |

# CONSTRUCTION METHODS

**610-3.1 General.** The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the RPR.

**610-3.2 Concrete Mixture.** The concrete shall develop a compressive strength of 4000 psi, ***unless otherwise noted in the Project Drawings***,in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard (280 kg per cubic meter). The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall be 5% +/- 1.2% as determined by ASTM C231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C143.

**610-3.3 Mixing.** Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or ASTM C685.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F (4°C) without the RPRs approval. If approval is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material is not permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

**610-3.4 Forms**. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the RPR. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

**610-3.5 Placing reinforcement.** All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

**610-3.6 Embedded items.** Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

**610-3.7 Concrete Consistency**. The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ASTM C143.

**610-3.8 Placing concrete.** All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the RPR. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or

flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

**610-3.9 Vibration.** Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete.

**610-3.10 Joints.** Joints shall be constructed as indicated on the plans.

**610-3.11 Finishing.** All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.

**610-3.12 Curing and protection.** All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

**610-3.13 Cold weather placing.** When concrete is placed at temperatures below 40°F (4°C), follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

**610-3.14 Hot weather placing.** When concrete is placed in hot weather greater than 85ºF (30 ºC), follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

## QUALITY ASSURANCE (QA)

**610-4.1 Quality Assurance sampling and testing**. Concrete for each day's placement will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The RPR will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

**610-4.2 Defective work.** Any defective work that cannot be satisfactorily repaired as determined by the RPR, shall be removed and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

## METHOD OF MEASUREMENT

**610-5.1** Concrete shall be considered incidental and no separate measurement shall be made.

## BASIS OF PAYMENT

~~**610-6.1** Payment shall be made at the contract price [ by the number of cubic yards (cubic meters) based on batch tickets of material ] [ by the number of square yards (square meters) ] [ lump sum ] [ concrete shall be considered incidental and no separate payment shall be made. ] This price shall be full compensation for furnishing all materials including reinforcement and embedded items and for all preparation, delivery, installation, and curing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

~~Payment will be made under:~~

| | |
|---|---|
| ~~Item P-610-6.1~~ | ~~Concrete, [ per cubic yards (cubic meters) ] [ per square yards (square meters) ] [ lump sum ] [ incidental to other work items ]~~ |

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

| | |
|---|---|
| ASTM A184 | Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement |
| ASTM A615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A704 | Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement |
| ASTM A706 | Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement |
| ASTM A775 | Standard Specification for Epoxy-Coated Steel Reinforcing Bars |
| ASTM A884 | Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement |
| ASTM A934 | Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars |
| ASTM A1064 | Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM C31 | Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C33 | Standard Specification for Concrete Aggregates |
| ASTM C39 | Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C94 | Standard Specification for Ready-Mixed Concrete |
| ASTM C136 | Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates |
| ASTM C114 | Standard Test Methods for Chemical Analysis of Hydraulic Cement |
| ASTM C136 | Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C143 | Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C150 | Standard Specification for Portland Cement |
| ASTM C171 | Standard Specification for Sheet Materials for Curing Concrete |
| ASTM C172 | Standard Practice for Sampling Freshly Mixed Concrete |
| ASTM C231 | Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C260 | Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C309 | Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C311 | Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete |
| ASTM C494 | Standard Specification for Chemical Admixtures for Concrete |
| ASTM C618 | Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| ASTM C666 | Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing |
| ASTM C685 | Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing |

| | |
|---|---|
| ASTM C989 | Standard Specification for Slag Cement for Use in Concrete and Mortars |
| ASTM C1017 | Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete |
| ASTM C1077 | Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation |
| ASTM C1157 | Standard Performance Specification for Hydraulic Cement |
| ASTM C1260 | Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) |
| ASTM C1365 | Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis |
| ASTM C1602 | Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete |
| ASTM D1751 | Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types) |
| ASTM D1752 | Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction |

American Concrete Institute (ACI)

| | |
|---|---|
| ACI 305R | Hot Weather Concreting |
| ACI 306R | Cold Weather Concreting |
| ACI 308R | Guide to External Curing of Concrete |
| ACI 309R | Guide for Consolidation of Concrete |

## END OF ITEM P-610

# ITEM F-162 CHAIN-LINK FENCE

## DESCRIPTION

**162-1.1** This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades shown on the plans or established by the Engineer.

## MATERIALS

**162-2.1 Fabric.** The fabric shall be woven with a 9-gauge galvanized steel wire in a 2-inch (50 mm) mesh and shall meet the requirements of ASTM A392, Class 2.

**162-2.2 Barbed wire.** Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3, Chain Link Fence Grade.

**162-2.3 Posts, rails, and braces.** Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

- Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.
- ~~Roll Formed Steel Shapes (C Sections) shall conform to the requirements of Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.~~
- ~~Hot Rolled Shapes (H Beams) shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.~~
- ~~Aluminum Pipe shall conform to the requirements of Group IB.~~
- ~~Aluminum Shapes shall conform to the requirements of Group IIB.~~
- ~~Vinyl or polyester coated steel shall conform to the requirements of ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.~~
- ~~Composite posts shall conform to the strength requirements of ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.~~
- ~~Posts, rails, and braces furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.~~

~~Posts, rails, and braces, with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:~~

- ~~External: 1,000 hours with a maximum of 5% red rust.~~
- ~~Internal: 650 hours with a maximum of 5% red rust.~~

The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Federal Specification RR-F-191/3.

**162-2.4 Gates.** Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 162-2.3. The fabric shall be of the same type material as used in the fence. ***A gate keeper shall be provided for every gate leaf over 5 feet.***

**162-2.5 Wire ties and tension wires.** Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824.

All material shall conform to Federal Specification RR-F-191/4.

**162-2.6 Miscellaneous fittings and hardware.** Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

**162-2.7 Concrete.** Concrete shall have a minimum 28-day compressive strength of 3000 psi (2670 kPa). ***"Bag Mix" concrete is not allowed.***

**162-2.8 Marking.** Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

## CONSTRUCTION METHODS

**162-3.1 General.** The fence shall be constructed in accordance with the details on the plans and as specified here using new materials. All work shall be performed in a workmanlike manner satisfactory to the Engineer. The Contractor shall layout the fence line based on the plans. The Contractor shall span the opening below the fence with barbed wire at all locations where it is not practical to conform the fence to the general contour of the ground surface because of natural or manmade features such as drainage ditches. The new fence shall be permanently tied to the terminals of existing fences as shown on the plans. The Contractor shall stake down the woven wire fence at several points between posts as shown on the plans.

The Contractor shall arrange the work so that construction of the new fence will immediately follow the removal of existing fences. The length of unfenced section at any time shall not exceed 300 feet (90 m). The work shall progress in this manner and at the close of the working day the newly constructed fence shall be tied to the existing fence.

**162-3.2 Clearing fence line.** Clearing shall consist of the removal of all stumps, brush, rocks, trees, or other obstructions that will interfere with proper construction of the fence. Stumps within the cleared area of the fence shall be grubbed or excavated. The bottom of the fence shall be placed a uniform distance above ground, as specified in the plans. When shown on the plans or as directed by the Engineer, the existing fences which interfere with the new fence location shall be removed by the Contractor as a part of the construction work unless such removal is listed as a separate item in the bid schedule. All holes remaining after post and stump removal shall be refilled with suitable soil, gravel, or other suitable material and compacted with tampers.

The cost of removing and disposing of the material shall ~~not constitute a pay item and shall be considered incidental to fence construction~~ be as described in P-151, Clearing and Grubbing.

**162-3.3 Installing posts.** All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole 2 inches (50 mm) larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches (300 mm). After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

**162-3.4 Installing top rails.** The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.

**162-3.5 Installing braces.** Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

**162-3.6 Installing fabric.** The wire fabric shall be firmly attached to the posts and braced as shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

**162-3.7 Electrical grounds.** Electrical grounds shall be constructed where a power line passes over the fence and at 500 feet (150 m) intervals. The ground shall be installed directly below the point of crossing. The ground shall be accomplished with a copper clad rod 8 feet (2.4 m) long and a minimum of 5/8 inches (16 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

**162-3.8 Cleaning up.** The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T-901.

## METHOD OF MEASUREMENT

**162-4.1** Chain-link fence will be measured for payment by the linear foot ~~(meter)~~. Measurement will be along the top of the fence from center to center of end posts, excluding the length occupied by gate openings.

**162-4.2** Gates will be measured as complete units.

## BASIS OF PAYMENT

**162-5.1** Payment for chain-link fence will be made at the contract unit price per linear foot ~~(meter)~~.

**162-5.2** Payment for vehicle or pedestrian gates will be made at the contract unit price for each gate.

The price shall be full compensation for furnishing all materials, and for all preparation, erection, and installation of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

| | |
|---|---|
| Item F-162-5.1 | Install and Remove Temporary 7' High Fence with 3 Strands Barbed Wire, 1 Foot Barbed Wire Extension Arms, Top and Bottom Tension Wire Including Grounding, and all other Appurtenances Required for a Complete Fence, Installed in Turf or Pavement – per linear foot |
| Item F-162-5.2 | Install and Remove Temporary 16’ Wide Swing Gate, 7’ High, 3 Strands Barbed Wire – per each |

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM International (ASTM)

| | |
|---|---|
| ASTM A121 | Standard Specification for Metallic-Coated Carbon Steel Barbed Wire |
| ASTM A153 | Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A392 | Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric |
| ASTM A491 | Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric |
| ASTM A824 | Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence |
| ASTM B117 | Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM F668 | Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric |
| ASTM F1043 | Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework |
| ASTM F1083 | Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures |
| ASTM F1183 | Standard Specification for Aluminum Alloy Chain Link Fence Fabric |
| ASTM F1345 | Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric |
| ASTM G152 | Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |
| ASTM G153 | Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |
| ASTM G154 | Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials |
| ASTM G155 | Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials |

Federal Specifications (FED SPEC)

| | |
|---|---|
| FED SPEC RR-F-191/3 | Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) |
| FED SPEC RR-F-191/4 | Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) |

FAA Standard

| | |
|---|---|
| FAA-STD-019 | Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment |

FAA Orders

| | |
|---|---|
| 5300.38 | AIP Handbook |

## END OF ITEM F-162

# ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

## DESCRIPTION

**108-1.1** This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in Item L-110, Airport Underground Electrical Duct Banks and Conduits.

## EQUIPMENT AND MATERIALS

**108-2.1 General.**

**a.** Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

**b.** All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

**c.** Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

**d.** All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

**e.** The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

**f.** All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26B, Maintenance Airport Visual aid Facilities, Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

Only Third Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

**108-2.2 Cable.** Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #8 American wire gauge AWG), L-824, Type C , 5,000 volts, nonshielded, with cross-linked polyethylene insulation. ~~Conductors for use on 20 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 AWG, L-824 Type C , 5,000 volts, nonshielded, with cross-linked polyethylene insulation.~~ L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Wire for electrical circuits up to 600 volts shall comply with Specification L-824 and/or Federal Specification J-C-30 and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

**108-2.3 Bare copper wire (counterpoise, bare copper wire ground and ground rods).** Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for ground wire per ASTM B3 and ASTM B8, and shall be bare copper wire per ASTM B33. See AC 150/5340-30 for additional details about counterpoise and ground wire types and installation. For voltage powered circuits, the equipment ground conductor shall be minimum No. 6 AWG, 600V rated, Type XHHW insulated, green color, stranded copper equipment ground conductor.

Ground rods shall be copper clad. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet long and 3/4 inch in diameter.

**108-2.4 Cable connections.** In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

**a. The cast splice.** A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, "Scotchcast" Kit No. 82-B, or as manufactured by Hysol® Corporation, "Hyseal Epoxy Splice" Kit No. E1135, or an approved equivalent, used for potting the splice is acceptable.

**b. The field-attached plug-in splice.** Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is acceptable for field attachment to single conductor cable. It shall be the Contractor's responsibility to determine the outside diameter of the cable to be spliced and to furnish appropriately sized connector kits and/or adapters and heat shrink tubing with integral sealant.

**c. The factory-molded plug-in splice.** Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

**d. The taped or heat-shrink splice.** Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are

designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent.

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer's recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. See AC 150/5340-30 for additional information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made per the manufacturer's recommendations and listings.

**108-2.5 Splicer qualifications.** Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Engineer proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

**108-2.6 Concrete.** Concrete for cable markers shall be per Specification Item P-610, Structural Portland Cement Concrete.

**108-2.7 ~~Flowable backfill.~~** ~~Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.~~

**108-2.8 Cable identification tags.** Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

**108-2.9 Tape.** Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

**108-2.10 Electrical coating.** Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

**108-2.11 Existing circuits.** Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

**108-2.12 Detectable warning tape.** Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

## CONSTRUCTION METHODS

**108-3.1 General.** The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Wherever possible, cable shall be run without splices, from connection to connection.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed or at least once in each access point where L-823 connectors are not installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

**108-3.2 Installation in duct banks or conduits.** This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

**108-3.3 ~~Installation of direct buried cable in trenches.~~** ~~Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.~~

~~Where cables must cross over each other, a minimum of 3 inches (75 mm) vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.~~

**~~a. Trenching.~~** ~~Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches (0.5 m) below finished grade per NEC Table 300.5, except as follows:~~

**~~(1)~~** ~~When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches (91 cm) unless otherwise specified.~~

**~~(2)~~** ~~Minimum cable depth when crossing under a railroad track, shall be 42 inches (1 m) unless otherwise specified.~~

~~Dewatering necessary for cable installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay items as part of Item L-108. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-108 Item.~~

~~The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.~~

~~When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch (6 mm) sieve. Flowable backfill material may alternatively be used. The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.~~

~~Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.~~

~~It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:~~

**~~(1)~~** ~~Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.~~

**~~(2)~~** ~~Trenching, etc., in cable areas shall then proceed, with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.~~

~~In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair or replacement.~~

**~~b. Backfilling.~~** ~~After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall be 3 inches (75 mm) deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch (6 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one inch (25 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter.~~

~~The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil, and to the satisfaction of the Engineer. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.~~

~~If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the compaction requirements per Item P-152 for that area shall be followed.~~

~~Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turfing operation to be accommodated. A proper allowance for settlement shall also be provided. Any excess excavated material shall be removed and disposed of per the plans and specifications.~~

~~Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches (150 mm) above the direct buried cable or the counterpoise wire if present. A 4-6 inch (100 – 150 mm) wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct buried cable or counterpoise. The tape shall be of the color and have a continuous legend as indicated on the plans. The tape shall be installed 8 inch (200 mm) minimum below finished grade.~~

~~**c. Restoration.** Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the sodding as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions and compaction shall meet the requirements of Item P-152. Restoration shall be considered incidental to the pay item of which it is a component part.~~

**108-3.4 Cable markers for direct-buried cable.** The location of direct buried circuits shall be marked by a concrete slab marker, 2 feet ~~(60 cm)~~ square and 4-6 inch ~~(10 – 15 cm)~~ thick, extending approximately one inch ~~(25 mm)~~ above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet ~~(61 m)~~ along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word “CABLE” and directional arrows on each cable marking slab. The letters shall be approximately 4 inches ~~(100 mm)~~ high and 3 inches ~~(75 mm)~~ wide, with width of stroke 1/2 inch ~~(12 mm)~~ and 1/4 inch ~~(6 mm)~~ deep.

At the location of each underground cable connection, except at lighting units, or isolation transformers, or power a concrete marker slab must mark adapters placed above the connection. The Contractor shall impress the word “SPLICE” on each slab. The Contractor also shall impress additional circuit identification symbols on each slab as directed by the Engineer. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint as approved by the Engineer. Furnishing and installation of cable markers is incidental to the respective cable pay item.

**108-3.5 Splicing.** Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

**a. Cast splices.** These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer’s instructions and to the satisfaction of the Engineer.

**b. Field-attached plug-in splices.** These shall be assembled per the manufacturer’s instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches ~~(38 mm)~~ on each side of the joint.

**c. Factory-molded plug-in splices.** These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic

rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches ~~(38 mm)~~ on each side of the joint.

**d. Taped or heat-shrink splices.** A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch ~~(6 mm)~~ of bare conductor on each side of the connector. Prior to splicing, the two ends of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches ~~(75 mm)~~ on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

**108-3.6 Bare counterpoise wire installation for lightning protection and grounding.** If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables. The Engineer shall select one of two methods of lightning protection for the airfield lighting circuit based on the frequency of local lightning:

**a. Equipotential.** – may be used by the Engineer for areas that have high rates of lightning strikes. This is where the counterpoise is bonded to the light base (edge lights included) and counterpoise size is determined by the Engineer.

~~**b. Isolation** – used in areas where lightning strikes are not common. The counterpoise is not bonded to edge light fixtures, in-pavement fixtures are boned to the counterpoise. Counterpoise size is selected by the Engineer.~~

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables.

- For edge light fixtures installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable.
    - The counterpoise conductor shall be installed 8 inches (203 mm) minimum below grade.
    - Each light base or mounting stake shall be provided with a grounding electrode.
    - When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.
    - When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

- For raceways installed under pavement; for raceways and cables not installed adjacent to the full strength pavement edge; for fixtures installed in full strength pavement and shoulder pavement and for optional method of edge lights installed in turf (stabilized soils); and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be centered over the raceway or cable to be protected as described below.
    - The counterpoise conductor shall be installed no less than 8 inches (203 mm) above the raceway or cable to be protected, except as permitted below.
    - The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.
    - Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.
    - The counterpoise conductor shall be installed no more than 12 inches (305 mm) above the raceway or cable to be protected.
    - The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection.
    - The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system.

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet ~~(150 m)~~ apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

If shown on the plans or in the specifications, a separate equipment (safety) ground system shall be provided in addition to the counterpoise wire using one of the following methods:

**c.** A ground rod installed at and securely attached to each light fixture base, mounting stake, and to all metal surfaces at junction/access structures via #6 AWG wire.

**d.** For parallel voltage systems only, install a #6 AWG green insulated equipment ground conductor internal to the conduit system and securely attached it to each light fixture base internal grounding lug and to all metal surfaces at junction/access structures. Dedicated ground rods shall be installed and exothermically welded to the counterpoise wires at each end of a duct bank crossing under pavement.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

**108-3.7 Counterpoise installation above multiple conduits and duct banks.** Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

**108-3.8 Counterpoise installation at existing duct banks.** When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

**108-3.9 Exothermic bonding.** Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

**a.** All slag shall be removed from welds.

**b.** Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

**c.** If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

**108-3.10 Testing.** The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

**a.** Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

**b.** Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

**c.** That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

**d.** That all affected circuits (existing and new) are free from unspecified grounds.

**e.** That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than 100 megohms.

**f.** That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

**g.** That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

**h.** That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

**i.** That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved "repair" procedures for items that have failed testing other than complete replacement.

## METHOD OF MEASUREMENT

**108-4.1** The cost of all excavation, backfill, dewatering and restoration regardless of the type of material encountered shall be included in the unit price bid for the work.

**108-4.2** Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet ~~(meters)~~ installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall include additional quantities required for slack.

**108-4.3** Ground rods***, and grounding connectors.*** ~~shall be measured by each 10-foot section installed complete.~~

## BASIS OF PAYMENT

**108-5.1** Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item.

Payment will be made under:

| | |
|---|---|
| Item L-108-5.1 | L-824, 1/C, No. 8 Type C Stranded Copper, 5 KV Cable, Including L-823 Connectors Installed in Duct or Conduit – per linear foot |
| Item L-108-5.2 | No. 6 Bare Counterpoise Wire, Installed in Duct or Trench, Including Ground Rods and Ground Connectors - per linear foot |
| Item L-108-5.3 | Remove Existing Cable in Conduit – per lump sum |
| Item L-108-5.4 | Install 2 – 12 Strand Multi-Mode 50/125 TC Rated Fiber Optic Cable – per linear foot |
| Item L-108-5.5 | L-824, 1/C, No. 6 Type C Stranded Copper, 5 KV Cable, Including L-823 Connectors Installed in Duct or Conduit – per linear foot |
| Item L-108-5.6 | #6 XHWH Ground Connector, Installed in Duct or Conduit – per linear foot |
| Item L-108-5.7 | L-824, 1/C, No. 8 Type C Stranded Copper, 5 KV Cable, Including L-823 Connectors Installed in Duct or Conduit for Future Taxiways – per linear foot |
| Item L-108-5.8 | Ground Rods Including Grounding Connectors – per each |

## MATERIAL REQUIREMENTS

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|---|---|---|---|
| AC 150/5340-26 | Maintenance of Airport Visual Aid Facilities | | |
| AC 150/5340-30 | Design and Installation Details for Airport Visual Aids | | |
| AC 150/5345-7 | Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits | | |
| AC 150/5345-26 | Specification for L-823 Plug and Receptacle, Cable Connectors | | |
| AC 150/5345-53 | Airport Lighting Equipment Certification Program | | |
| Commercial | Item | Description | A-A-59544 |
| | Cable and Wire, Electrical (Power, Fixed Installation) | | |
| Commercial | Item | Description | A-A-55809 |
| | Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic | | |
| ASTM B3 | Standard Specification for Soft or Annealed Copper Wire | | |

| | |
|---|---|
| ASTM B8 | Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM B33 | Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes |
| ASTM D4388 | Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes |
| FED SPEC J-C-30 | Cable and Wire, Electrical (Power, Fixed Installation) |
| MIL-I-24391 | Insulation Tape, Electrical, Plastic, Pressure Sensitive |

## REFERENCE DOCUMENTS

| | |
|---|---|
| NFPA-70 | National Electrical Code (NEC) |
| NFPA-780 | Standard for the Installation of Lightning Protection Systems |
| MIL-S-23586F | Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical |
| ANSI/IEEE STD 81 | IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System |

## END OF ITEM L-108

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# ITEM L-109 AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT

## DESCRIPTION

**109-1.1** This item shall consist of removing an existing airport transformer vault and equipment and; constructing an airport transformer vault or a prefabricated metal housing per these specifications and per the design and dimensions shown in the plans. This work shall also include the installation of conduits in the floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals that are necessary to produce a completed unit. Included as a separate part under this item or as a separate item where an existing vault is to be used shall be the furnishing of all vault equipment, wiring, electrical buses, cable, conduit, potheads, and grounding systems. This work shall also include the painting of equipment and conduit; the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the RPR.

Where this specification is in conflict with other technical specifications or divisions, those specifications or divisions shall govern.

## EQUIPMENT AND MATERIALS

**109-2.1 General.**

**a.** Airport lighting equipment and materials covered by advisory circulars (AC) shall be certified in AC 150/5345-53, Airport Lighting Equipment Certification Program (ALECP) and listed in the ALECP Addendum.

**b.** All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the RPR.

**c.** Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

**d.** All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

**e.** The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

**f.** All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

### CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

**109-3.1 Electrical vault building.** The electrical vault building must comply with NEC Article 110.31, Enclosure for Electrical Installations, Item (A) Electrical Vaults. Construct the building of materials having adequate structural strength for the conditions and installed location, has a minimum fire rating of two or three hours as determined by the authority having jurisdiction (AHJ), and is bullet resistant to minimum UL 752 Level 4.

**109-3.2 Concrete.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures.

**109-3.3 Precast concrete structures.** ~~Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another RPR approved third party certification program. Precast concrete structures shall conform to ASTM C478.~~ ***NOT USED***.

**109-3.4 Reinforcing steel.** Reinforcing steel bars shall be intermediate or structural grade deformed-type bars and shall be per ASTM A615.

**109-3.5 Brick.** ~~Brick shall be per ASTM C62, Grade SW.~~ ***NOT USED***.

**109-3.6 Rigid steel conduit.** Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6 and 514B.

**109-3.7** Plastic Conduit and fittings. Plastic Conduit and fittings shall conform to the requirements of UL-651 and UL-654 schedule 40 polyvinyl chloride (PVC) suitable for use above or below ground.

**109-3.8 Lighting.** Vault or metal-housing light fixtures shall be of a vapor-proof type.

**109-3.9 Outlets.** Convenience outlets shall be heavy-duty duplex units designed for industrial service.

**109-3.10 Switches.** Vault or metal-housing light switches shall be single-pole switches.

**109-3.11 Paint.**

**a.** Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer compatible with the manufacturer's recommendations for the intermediate or topcoat.

**b.** White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint conforming to the Master Painter's Institute (MPI), Reference #9, Exterior Alkyd, Gloss.

**c.** Priming paint for wood surfaces shall be mixed on the job by thinning the specified white paint by adding 1/2 pint (0.24 liter) of raw linseed oil to each gallon (liter).

**d.** Paint for the floor, ceiling, and inside walls shall be per Porter Paint Company 69, 71, and 79 or equivalent. Walls and ceiling shall be light gray and the floor shall be medium gray.

~~**e.** The roof coating shall be hot asphalt material per ASTM D2823. Asbestos-free roof coating per ASTM D4479 may be substituted if required by local codes.~~

**109-3.12 Ground bus.** Ground bus shall be 1/8 × 3/4 inch (3 × 19 mm) minimum copper bus bar.

**109-3.13 Square duct.** Duct shall be square similar to that manufactured by the Square D Company (or equivalent), or the Trumbull Electric Manufacturing Company (or equivalent). The entire front of the duct on each section shall consist of hinged or removable cover for ready access to the interior. The cross-section of the duct shall be not less than 4 × 4 inch (100 × 100 mm) except where otherwise shown in the plans.

**109-3.14 Ground rods.** Ground rods shall be in accordance with Item L-108.

**109-3.15 Vault prefabricated metal housing.** ~~The prefabricated metal housing shall be a commercially available unit~~. ***NOT USED***.

**109-3.16 FAA-approved equipment.** Certain items of airport lighting equipment installed in vaults are covered by individual ACs listed below:

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|---|---|
| AC 150/5345-3 | Specification for L-821, Panels for Remote Control of Airport Lighting |
| AC 150/5345-5 | Circuit Selector Switch |
| AC 150/5345-7 | Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits |
| AC 150/5345-10 | Specification for Constant Current Regulators and Regulator Monitors |
| AC 150/5345-13 | Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits. |

| | |
|---|---|
| AC 150/5345-49 | Specification for L-854, Radio Control Equipment |
| AC 150/5345-56 | Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS) |

**109-3.17 Other electrical equipment.** Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other regularly used commercial items of electrical equipment not covered by FAA equipment specifications and ACs shall conform to the applicable rulings and standards of the Institute of Electrical and Electronic Engineers (IEEE) or the National Electrical Manufacturers Association (NEMA). When specified, test reports from a testing laboratory indicating that the equipment meets the specifications shall be supplied. In all cases, equipment shall be new and a first-grade product. This equipment shall be supplied in the quantities required for the specific project and shall incorporate the electrical and mechanical characteristics specified in the proposal and plans. Equipment selected and installed by the Contractor shall maintain the interrupting current rating of the existing systems or specified rating whichever is greater.

**109-3.18 Wire.** Wire (in conduit) rated up to 5,000 volts shall be per AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be of the type, size, number of conductors, and voltage shown in the plans or in the proposal.

**a. Control circuits.** Unless otherwise indicated on the plans, wire shall be not less than No. 12 American wire gauge (AWG) and shall be insulated for 600 volts. If telephone control cable is specified, No. 19 AWG telephone cable per ANSI/Insulated Cable Engineers Association (ICEA) S-85-625 specifications shall be used.

**b. Power circuits.**

**(1)** 600 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 600 volts.

**(2)** 3,000 volts maximum – Wire shall be No. 6 AWG or larger and insulated for at least 3,000 volts.

**(3)** Over 3,000 volts-Wire shall be No. 6 AWG or larger and insulated for at least the circuit voltage.

**109-3.19 Short circuit / coordination / device evaluation / arc flash analysis.** The Contractor shall, based upon the equipment provided, include as a part of the submittal process the electrical system "Short Circuit / Coordination / Device evaluation / Arc Flash Analysis". The analysis shall be performed by the equipment manufacturer and submitted in a written report. The analysis shall be signed and sealed by a registered professional Engineer from the state in which the project is located. The analysis shall comply with NFPA-70E and IEEE 1584.

The analysis will include: one line diagrams, short circuit analysis, coordination analysis, equipment evaluation, arc flash analysis and arc flash labels containing at a minimum, equipment name, voltage/current rating, available incident energy and flash protection boundary.

The selected firms field service Engineer shall perform data gathering for analysis completion and device settings, perform device setting as recommended by the analysis and will furnish and install the arc flash labels. The components worst case incident energy will be considered the available arc flash energy at that specific point in the system. Submit three written copies and one electronic copy of the report.

# CONSTRUCTION METHODS

## CONSTRUCTION OF VAULT AND PREFABRICATED METAL HOUSING

**109-4.1 General.** The Contractor shall construct the transformer vault or prefabricated metal housing at the location indicated in the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown in the plans. Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program.

The Contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet (3 m) on all sides. The slope shall be not less than 1/2 inch per foot (12 mm per 0.3 m) away from the vault or metal housing in all directions.

The vault shall provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault shall have sufficient filtered ventilation, to assure that the interior room temperatures and conditions do not exceed the recommended limits of the electrical equipment to be installed in the vault. The Contractor is responsible for contacting the manufacturer of the equipment to be installed to obtain environmental limitations of the equipment to be installed. Refer to the electrical vault detail plan sheets for construction requirements.

**109-4.2 Foundation and walls.**

**a. Reinforced concrete construction.** The Contractor shall construct the foundation and walls per the details shown in the plans. Unless otherwise specified, internal ties shall be of the mechanical type so that when the forms are removed the ends of the ties shall be at least one inch (25 mm) beneath the concrete surface; the holes shall be plugged and finished to prevent discoloration. Reinforcing steel shall be placed, as shown in the drawings, and secured in position to prevent displacement during the concrete placement.

The external surfaces of the concrete shall be thoroughly worked during the placing operation to force all coarse aggregate from the surface. Thoroughly work the mortar against the forms to produce a smooth finish free from air pockets and honeycomb.

The surface film of all pointed surfaces shall be removed before setting occurs. As soon as the pointing has set sufficiently, the entire surface inside and outside of the vault shall be thoroughly wet with water and rubbed with a No. 16 carborundum stone, or equivalent quality abrasive, bringing the surface to a paste. All form marks and projections shall be removed. The surface produced shall be smooth and dense without pits or irregularities. The materials which have been ground into a paste during the rubbing process shall be spread or brushed uniformly over the entire surface (except the interior surfaces that are to be painted shall have all paste removed by washing before painting) and permitted to reset. Final exterior finish shall be obtained by rubbing with No. 30 carborundum stone, or an equivalent quality abrasive. The surface shall be rubbed until the entire surface is smooth and uniform in color.

~~**b. Brick and concrete construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The outer edge of the foundation at the floor level shall be beveled 1-1/2 inches (38 mm) at 45 degrees. Brick walls shall be 8 inches (200 mm) thick, laid in running bond with every sixth course a header course. Brick shall be laid in cement mortar (one part masonry cement and 3 parts sand) with full mortar bed and shoved joints. All joints shall be completely filled with mortar, and facing brick shall be back-parged with mortar as work progresses. All joints shall be 3/8 inch (9 mm) thick, exterior joints tooled concave, and interior joints struck flush. Both interior and exterior brick surfaces shall be cleaned and nail holes, cracks and other defects filled with mortar. When specified, a nonfading mineral pigment mortar coloring shall be added to the mortar. Steel reinforcing bars, 3/8 inch (9 mm) in diameter and 12 inches (300 mm) long, shall be set vertically in the center of the brick wall on not more than 2 feet (60 cm) centers to project 2-1/2 inches (60 mm) into the concrete roof slab. Lintels for supporting the brickwork over doors, windows, and louvers shall consist of two 4 × 3 × 3/8 inch (100 × 75 × 9 mm) steel angles. Lintels shall be painted with one coat of corrosion inhibiting primer before installation, and all exposed parts shall be painted similar to doors and window sash after installation.~~

~~Window sills may be concrete poured in place or precast concrete as indicated in the plans. All exposed surfaces shall have a rubbed finish as specified under reinforced concrete construction. After completion, all interior and exterior faces of walls shall be scrubbed with a solution of muriatic acid and water in the proportions of not less than one part acid to 10 parts of water. All traces of efflorescence, loose mortar, and mortar stain shall be removed, and the walls washed down with clear water.~~

**c. Concrete masonry construction.** When this type of construction is specified, the foundation shall be concrete conforming to the details shown in the plans. The concrete masonry units shall be standard sizes and shapes and shall conform to ASTM C90 and shall include the closures, jambs, and other shapes required by the construction as shown in the plans. Standard construction practice shall be followed for this type of work including mortar, joints, reinforcing steel for extensions into roof slab, etc. Plaster for interior walls, if specified, shall be Portland cement plaster.

**109-4.3 Roof.** The roof shall be reinforced concrete ***or*** as shown in the plans. Reinforcing steel shall be placed as shown in the drawing and secured in position to prevent displacement during the pouring of the concrete. The concrete shall be poured monolithically and shall be free of honeycombs and voids. The surface shall have a steel-troweled finish and shall be sloped as shown in the drawing. The underside of the roof slab shall be finished in the same manner as specified for walls.

One brush or mop coat of hot asphalt roof coating shall be applied to the top surface of the roof slab. The asphalt material shall be heated to within the range specified by the manufacturer and immediately applied to the roof. The finished coat shall be continuous over the roof surface and free from holidays and blisters. Smears and dribbles of asphalt on the roof edges and building walls shall be removed.

**109-4.4 Floor.** Construct building foundation in accordance with the details shown in the plans. The floor shall be reinforced concrete as shown in the drawings. When present, all sod, roots, refuse, and other perishable material shall be removed from the area under the floor to a depth of 8 inches (200 mm), unless a greater depth is specified in the invitation for bids. This area shall be backfilled with materials consisting of sand, cinders, gravel, or stone. Fill shall be placed in layers not to exceed 4 inches (100 mm) and shall be thoroughly compacted by tamping or rolling. A layer of building paper shall be placed over the fill prior to placing concrete. The floor surfaces shall have a steel-troweled finish. The floor shall be level unless a drain is specified, in which case the floor shall be pitched 1/4 inch (6 mm) per foot downward toward the drain. A 1/4-inch (6-mm) asphalt felt expansion joint shall be placed between floor and foundation walls. The floor shall be poured monolithically and shall be free of honeycombs and voids.

**109-4.5 Floor drain.** If shown in the plans, a floor drain and dry well shall be installed in the center of the floor of the equipment room. The dry well shall be excavated 4 × 4 feet (1.2 × 1.2 m) square and to a depth of 4 feet (1.2 m) below the finished floor elevation and shall be backfilled to the elevation of the underside of the floor with gravel - which shall all pass a 2-inch (50 mm) mesh sieve and shall all be retained on a 1/4-inch (6.3 mm) mesh sieve. The gravel backfill shall be placed in 6 inch (150 mm) maximum layers, and the entire surface of each layer shall be tamped either with a mechanical tamper or with a hand tamper weighing not less than 25 pounds (11 kg) and having a face area of not more than 36 square inches (232 square cm) nor less than 16 square inches (103 square cm). The drain inlet shall be set flush in the concrete floor. The drain shall have a clear opening of not less than 8 inches (200 mm) in diameter.

**109-4.6 Conduits in floor and foundation.** Conduits shall be installed in the floor and through the foundation walls per the details shown in the plans. All underground conduit shall be painted with an asphalt compound. Conduit shall be installed with a coupling or metal conduit adapter flush with the top of the floor. All incoming conduit shall be closed with a pipe plug to prevent the entrance of foreign material during construction. Space conduit entrances shall be left closed.

**109-4.7 Doors.** Doors shall be metal-clad fireproof Class A (three (3) hour rated) doors conforming to requirements of the National Electrical Code (NEC) and local electrical codes. Panic bar exit hardware shall be installed per NEC requirements. Refer to the new electrical vault detail plan sheets for construction requirements.

**109-4.8 Painting.** The floor, ceiling, and inside walls of concrete construction shall first be given a hardening treatment, after which the Contractor shall apply two coats of paint as specified below, except that interior face brick walls need not be painted. The hardening treatment shall consist of applying two coats of either a commercial floor hardener or a solution made by dissolving 2 pounds (0.9 kg) of magnesium fluorosilicate or zinc sulfate crystals in one gallon (liter) of water. Each coat shall be allowed to dry at least 48 hours before the next application. After the second treating coat has dried, the surfaces shall be brushed clean of all crystals and thoroughly washed with clear water. Paint for walls and ceiling shall be a light gray color approved by the RPR. The floor paint shall be a medium gray color approved by the RPR. Before painting, the surfaces shall be dry and clean. The first coat shall be thinned by adding 2/3-quart (0.63 liters) of spar varnish and 1/3-quart (0.31 liters) of turpentine to each gallon (liter) of paint. The second coat shall be applied without thinning. All doors, lintels, and windows shall be cleaned to remove any rust or foreign material and shall be given one body and one finish coat of white paint. Bare metal surfaces shall be given a prime coat of corrosion-inhibiting primer prior to the body and finish coats.

**109-4.9 Lights and switches.** The Contractor shall furnish and install a minimum of two duplex convenience outlets in the vault room. Where a control room is specified, at least two duplex outlets shall be installed.

## INSTALLATION OF EQUIPMENT IN VAULT OR PREFABRICATED METAL HOUSING

**109-5.1 General.** The Contractor shall furnish, install, and connect all equipment, equipment accessories, conduit, cables, wires, buses, grounds, and support necessary to ensure a complete and operable electrical distribution center for the airport lighting system as specified herein and shown in the plans. When specified, an emergency power supply and transfer switch shall be provided and installed.

The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction. All electrical work shall comply with the NEC and local code agency having jurisdiction including the separation of under 600V work from 5,000V work."

**109-5.2 Power supply equipment.** Transformers, regulators, booster transformers, and other power supply equipment items shall be furnished and installed at the location shown in the plans or as directed by the RPR. The power supply equipment shall be set on steel "H" sections, "I" beams, channels, or concrete blocks to provide a minimum space of 1-1/2 inch (38 mm) between the equipment and the floor. The equipment shall be placed so as not to obstruct the oil-sampling plugs of the oil-filled units; and name-plates shall, so far as possible, not be obscured.

If specified in the plans and specifications, equipment for an alternate power source or an emergency power generator shall be furnished and installed. The alternate power supply installation shall include all equipment, accessories, an automatic changeover switch, and all necessary wiring and connections. The emergency power generator set shall be the size and type specified.

**109-5.3 Switchgear and panels.** Oil switches, fused cutouts, relays, transfer switches, panels, panel boards, and other similar items shall be furnished and installed at the location shown in the plans or as directed by the RPR. Wall or ceiling mounted items shall be attached to the wall or ceiling with galvanized bolts of not less than 3/8-inch (9 mm) diameter engaging metal expansion shields or anchors in masonry or concrete vaults.

**109-5.4 Duct and conduit.** The Contractor shall furnish and install square-type exposed metallic ducts with hinged covers for the control circuits in the vault. These shall be mounted along the walls behind all floor-mounted equipment and immediately below all wall-mounted equipment. The hinged covers shall be placed to open from the front side with the hinges at the front bottom.

Wall brackets for square ducts shall be installed at all joints 2 feet (60 cm) or more apart with intermediate brackets as specified. Conduit shall be used between square ducts and equipment or between different items of equipment when the equipment is designed for conduit connection. When the equipment is not designed for conduit connection, conductors shall enter the square-type control duct through insulating bushings in the duct or on the conduit risers.

**109-5.5 Wiring and connections.** The Contractor shall make all necessary electrical connections in the vault per the wiring diagrams furnished and as directed by the RPR. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block. This shall be accomplished by running each control lead the longest way around the box to the proper terminal. Leads shall be neatly laced in place.

**109-5.6 Marking and labeling.** All equipment, control wires, terminal blocks, etc., shall be tagged, marked, or labeled as specified below:

**a. Wire identification.** The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks. Wire labels, if used, shall be of the self-sticking preprinted type and of the manufacturer's recommended size for the wire involved. Identification -markings designated in the plans shall be followed. Tags, if used, shall be of fiber not less than 3/4 inch (19 mm) in diameter and not less than 1/32 inch (1 mm) thick. Identification markings designated in the plans shall be stamped on tags by means of small tool dies. Each tag shall be securely tied to the proper wire by a nonmetallic cord.

**b. Labels.** The Contractor shall stencil identifying labels on the cases of regulators, breakers, and distribution and control relay cases with white oil paint as designated by the RPR. The letters and numerals shall be not less than one inch (25 mm) in height and shall be of proportionate width. The Contractor shall also mark the correct circuit designations per the wiring diagram on the terminal marking strips, which are a part of each terminal block.

## METHOD OF MEASUREMENT

**109-6.1** The quantity of vaults to be paid for under this item shall consist of the number of vaults constructed in place and accepted as a complete unit.

~~**109-6.2** The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit~~.

**109-6.3** The quantity of equipment to be paid for under this item shall consist of all equipment installed, connected and accepted as a complete unit ready for operation within an existing vault or prefabricated metal housing.

## BASIS OF PAYMENT

**109-7.1** Payment will be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

| | |
|---|---|
| Item L-109-7.1 | Construct New Airfield Electrical Vault, Complete in Place - per lump sum |
| Item L-109-7.2 | Removal and Relocation of Existing Electrical Vault Equipment to New Electrical Vault (CCRs, Ace Units, FAA Equipment, Etc.), Complete in Place - per lump sum |
| Item L-109-7.3 | New Vault Electrical Fit Out Including All Power, Electrical Panels, and Lighting Systems not Incorporated in Other Bid Items, Complete in Place - per lump sum |
| Item L-109-7.4 | 300KW Generator Including Ventilation Shroud and all Appurtenance, Complete in Place - per lump sum |
| Item L-109-7.5 | 2,000 Gallon Double Wall AST Including Fill and Supply Accessories, Tank Monitoring System, Stairs, Etc., Complete in Place - per lump sum |
| Item L-109-7.6 | 10- Ton Packaged HVAC Unit Including PLC Controller, Ductwork Register and Grills, Etc., Complete in Place - per lump sum |
| Item L-109-7.7 | Wall Mounted Exhaust Fan - per lump sum |
| Item L-109-7.8 | 30KW Regulators, 5 Step with Ace Unit - per each |
| Item L-109-7.9 | 15KW Regulators, 3 Step with Ace Unit - per each |
| Item L-109-7.10 | 10KW Regulators, One 3 Step and One 5 Step with Ace Unit - per each |
| Item L-109-7.11 | 1200 AMP Automatic Transfer Switch - per lump sum |
| Item L-109-7.12 | Relocate Airfield Computerized Airfield Lighting System with New Computers, Touch Screens, Software, Laptop, Retrofit Existing CCRS with Ace-3, Programming, Beacon Radio, Wireless Connection, Etc., Complete in Place - per lump sum |
| Item L-109-7.13 | Power for New Electrical Vault Including Utility Service and Meter Socket, 24” x 36” Pull Boxes, 3-4” Conduits (HDD) with 3 Sets of 4 # 600 MCM Cable, 1200 AMP Service and Main Disconnect Switch, Complete In Place - per lump sum |
| Item L-109-7.14 | Power at Existing Electrical Vault Site Including Utility Service and Meter Socket, Connection to EM Panel, 60 AMP Service and Panel, Power for Gate L, New 60 KW Generator and Fuel System, Automatic Transfer Switch, Etc., Complete In Place - per lump sum |
| Item L-109-7.15 | Remote Access for ALCMS Management and Controlling, Notification for System Status and Failure Conditions Via Text and Email Using Cellular Service Carrier Including Hardware and Software for New Vault Computer and Laptop - per lump sum |
| Item L-109-7.16 | Existing Electrical Vault Demolition and Area Repairs - per lump sum |
| Item L-109-7.17 | Temporary Electrical Power for Terminal Systems During Conversion - per lump sum |

# REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Advisory Circulars (AC)

| | |
|---|---|
| AC 150/5340-30 | Design and Installation Details for Airport Visual Aids |
| AC 150/5345-3 | Specification for L-821, Panels for Remote Control of Airport Lighting |
| AC 150/5345-5 | Circuit Selector Switch |
| AC 150/5345-7 | Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits |
| AC 150/5345-10 | Specification for Constant Current Regulators and Regulator Monitors |
| AC 150/5345-13 | Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits |
| AC 150/5345-49 | Specification L-854, Radio Control Equipment; |
| AC 150/5345-53 | Airport Lighting Equipment Certification Program |

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

| | |
|---|---|
| ANSI/ICEA S-85-625 | Standard for Telecommunications Cable Aircore, Polyolefin Insulated, Copper Conductor Technical Requirements |

ASTM International (ASTM)

| | |
|---|---|
| ASTM A615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM C62 | Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale) |
| ASTM C90 | Standard Specification for Loadbearing Concrete Masonry Units |
| ASTM D2823 | Standard Specification for Asphalt Roof Coatings, Asbestos Containing |
| ASTM D4479 | Standard Specification for Asphalt Roof Coatings – Asbestos-Free |

Commercial Item Description (CID)

| | |
|---|---|
| A-A 59544 | Cable and Wire, Electrical (Power, Fixed Installation)<br>Institute of Electrical and Electronic Engineers (IEEE) |
| IEEE 1584 | Guide for Performing Arc-Flash Hazard Calculations |

Master Painter's Institute (MPI)

| | |
|---|---|
| MPI Reference #9 | Alkyd, Exterior, Gloss (MPI Gloss Level 6) |

Underwriters Laboratories (UL)

| | |
|---|---|
| UL Standard 6 | Electrical Rigid Metal Conduit – Steel |
| UL Standard 514B | Conduit, Tubing, and Cable Fittings |
| UL Standard 514C | Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers |
| UL Standard 651 | Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings |
| UL Standard 651A | Type EB and A Rigid PVC Conduit and HDPE Conduit |

National Fire Protection Association (NFPA)

| | |
|---|---|
| NFPA-70 | National Electrical Code (NEC) |
| NFPA-70E | Standard for Electrical Safety in the Workplace |
| NFPA-780 | Standard for the Installation of Lightning Protection Systems |

**END OF ITEM L-109**

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# ITEM L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

## DESCRIPTION

**110-1.1** This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete or buried in sand) installed per this specification at the locations and per the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandrelling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables per the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

## EQUIPMENT AND MATERIALS

**110-2.1 General.**

**a.** All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

**b.** Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, that comply with these specifications, at the Contractor's cost.

**c.** All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in project that accrue directly or indirectly from late submissions or resubmissions of submittals.

**d.** The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes specified in this document.

**e.** All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

**110-2.2 Steel conduit**. Rigid galvanized steel (RGS) conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standards 6, 514B, and 1242. All RGS conduits or RGS elbows installed below grade, in concrete, permanently wet locations or other similar environments shall be painted with a 10 mil thick coat of asphaltum sealer or shall have a factory bonded polyvinyl chloride (PVC) cover. Any exposed galvanizing or steel shall be coated with 10 mil of asphaltum sealer. When using PVC coated RGS conduit, care shall be exercised not to damage the factory PVC coating. Damaged PVC coating shall be repaired per the manufacturer's written instructions.

**110-2.3 Plastic conduit.** Plastic conduit and fittings-shall conform to the following requirements:

- UL 514B covers W-C-1094-Conduit fittings all types, classes 1 thru 3 and 6 thru 10.
- UL 514C covers W-C-1094- all types, Class 5 junction box and cover in plastic (PVC).
- UL 651 covers W-C-1094-Rigid PVC Conduit, types I and II, Class 4.
- UL 651A covers W-C-1094-Rigid PVC Conduit and high density polyethylene (HDPE) Conduit type III and Class 4.

Underwriters Laboratories Standards UL-651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

**a.** Type I–Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

**b.** Type II–Schedule 40 PVC suitable for either above ground or underground use.

**c.** Type III – Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

**d.** Type III –HDPE pipe, minimum standard dimensional ratio (SDR) 11, suitable for placement with directional boring under pavement.

The type of solvent cement shall be as recommended by the conduit/fitting manufacturer.

**110-2.4 Split conduit**. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

**110-2.5 Conduit spacers**. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads, They shall be designed to accept No. 4 reinforcing bars installed vertically.

**110-2.6 Concrete.** Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using **3/4** inch maximum size coarse aggregate with a minimum 28-day compressive strength of **4,000** psi. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

**110-2.7 ~~Flowable backfill.~~** ~~Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material. Fill shall be designed to achieve a 28-day compressive strength of 200 psi (1.4 MPa) under pavement.~~

**110-2.8 Detectable warning tape**. Plastic, detectable, American Public Works Association (APWA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metallized foil core and shall be 3-6 inches ~~(75-150 mm)~~ wide. Detectable tape is incidental to the respective bid item.

## CONSTRUCTION METHODS

**110-3.1 General**. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches ~~(50 mm)~~ inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches ~~(75 mm)~~ per 100 feet ~~(30 m)~~. On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be less than 18 inches ~~(0.5 m)~~ below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches ~~(0.5 m)~~ below the subgrade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc., interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the light bases, manholes, pull boxes, etc., and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be recleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200 pound ~~(90 kg)~~ test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminants from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet ~~(1.5 m)~~.

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement of the duct banks shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches ~~(75 mm)~~ below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch ~~(6 mm)~~ sieve. Flowable backfill may alternatively be used The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared per the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet ~~(60 cm)~~.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed per Item P-152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

All excavation shall be unclassified and shall be considered incidental to the respective L-110 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay item as a part of Item L-110. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-110 Item.

Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted per Item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables) cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

**a.** Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

**b.** Trenching, etc., in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

**110-3.2 Duct banks**. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches ~~(0.5 m)~~ below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches ~~(0.5 m)~~ below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet ~~(1 m)~~ beyond the edges of the pavement or 3 feet ~~(1 m)~~ beyond any under drains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches ~~(75 mm)~~ thick prior to its initial set. The Contractor shall space the conduits not less than 3 inch ~~(75 mm)~~ apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches ~~(75 mm)~~ thick unless otherwise shown on the plans. All conduits shall terminate with female ends for ease of access in current and future use. Install factory plugs in all unused ends. Do not cover the ends or plugs with concrete.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches ~~(150 mm)~~ to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot ~~(1.5 m)~~ intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5-foot ~~(1.5 m)~~ intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 to 6 inches ~~(75 to 150 mm)~~ wide tape, 8 inches ~~(200 mm)~~ minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3-inch ~~(75 mm)~~ wide tape only for single conduit runs. Utilize the 6-inch ~~(150 mm)~~ wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches ~~(600 mm)~~ in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Engineer.

**110-3.3 Conduits without concrete encasement**. Trenches for single-conduit lines shall be not less than 6 inches ~~(150 mm)~~ nor more than 12 inches ~~(300 mm)~~ wide. The trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches ~~(100 mm)~~ thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4 inch ~~(6 mm)~~ sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits within the Airport's secured area where trespassing is prohibited are at least 18 inches ~~(0.5 m)~~ below the finished grade. Conduits outside the Airport's secured area shall be installed so that the tops of the conduits are at least 24 inches ~~(60 cm)~~ below the finished grade per National Electric Code (NEC), Table 300.5.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches ~~(75 mm)~~ apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches ~~(150 mm)~~ apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be placed not less than 3 inches ~~(75 mm)~~ apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches ~~(150 mm)~~ apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches ~~(150 mm)~~ to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5-foot ~~(1.5 m)~~ intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

**110-3.4 Markers.** The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet ~~(60 cm)~~ square and 4 - 6 inches ~~(100 – 150 mm)~~ thick extending approximately one inch ~~(25 mm)~~ above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building. Each cable or duct run from a line of lights and signs to the equipment vault must be marked at approximately every 200 feet ~~(61 m)~~ along the cable or duct run, with an additional marker at each change of direction of cable or duct run.

The Contractor shall impress the word "DUCT" or "CONDUIT" on each marker slab. Impression of letters shall be done in a manner, approved by the Engineer, for a neat, professional appearance. All letters and words must be neatly stenciled. After placement, all markers shall be given one coat of high-visibility orange paint, as approved by the Engineer. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches ~~(100 mm)~~ high and 3 inches ~~(75 mm)~~ wide with width of stroke 1/2 inch (12 mm) and 1/4 inch ~~(6 mm)~~ deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

**110-3.5 Backfilling for conduits.** For conduits, 8 inches ~~(200 mm)~~ of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted per Item P-152 "Excavation and Embankment" except that material used for back fill shall be select material not larger than 4 inches ~~(100 mm)~~ in diameter.

~~Flowable backfill may alternatively be used.~~

Trenches shall not contain pools of water during back filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

**110-3.6 Backfilling for duct banks**. After the concrete has cured, the remaining trench shall be backfilled and compacted per Item P-152 "Excavation and Embankment" except that the material used for backfill shall be select material not larger than 4 inches ~~(100 mm)~~ in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet ~~(76 m)~~ of duct bank or one work period's construction, whichever is less.

~~Flowable backfill may alternatively be used.~~

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface; except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of per instructions issued by the Engineer.

**110-3.7 Restoration.** Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include sodding or seeding and mulching as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item. Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

## METHOD OF MEASUREMENT

**110-4.1** Underground conduits and duct banks shall be measured by the linear feet ~~(meter)~~ of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated material, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes.

## BASIS OF PAYMENT

**110-5.1** Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item per the provisions and intent of the plans and specifications.

Payment will be made under:

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| Item L-110-5.1 | 1W4" Underground Electrical Duct, Schedule 40 PVC, Non-Concrete Encased, including Trenching – per linear foot |
| Item L-110-5.2 | 1W4" Underground Electrical Duct, Directional Bored, Non-Concrete Encased, including Boring – per linear foot |
| Item L-110-5.3 | 2W4" Underground Electrical Duct, Schedule 40 PVC, Non-Concrete Encased, including Trenching – per linear foot |
| Item L-110-5.4 | 2W4" Underground Electrical Duct, Directional Bored, Non-Concrete Encased, including Boring – per linear foot |

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| Item L-110-5.5 | 4W4" Underground Electrical Duct, Schedule 40 PVC, Non-Concrete Encased, including Trenching – per linear foot |
| Item L-110-5.6 | 8W4" Underground Electrical Duct, Schedule 40 PVC, Concrete Encased, including Trenching and Pavement Patching– per linear foot |
| Item L-110-5.7 | 8W4" Underground Electrical Duct, Schedule 40 PVC, Non-Concrete Encased, including Trenching – per linear foot |
| Item L-110-5.8 | 8W4" Underground Electrical Duct, Directional Bored, Non-Concrete Encased, including Boring – per linear foot |

## MATERIAL REQUIREMENTS

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|---|---|
| Advisory Circular (AC) 150/5340-30 | Design and Installation Details for Airport Visual Aids |
| AC 150/5345-53 | Airport Lighting Equipment Certification Program |
| ASTM A615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM D1556 | Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D1557 | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft$^3$(2,700 kN-m/m$^3$)) |
| ASTM D2167 | Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method |
| ASTM D2922 | Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) |
| NFPA-70 | National Electrical Code (NEC) |
| Underwriters Laboratories | Standard 6<br>Electrical Rigid Metal Conduit - Steel |
| Underwriters Laboratories | Standard 514B<br>Conduit, Tubing, and Cable Fittings |
| Underwriters Laboratories | Standard 514C<br>Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers |
| Underwriters Laboratories | Standard 1242<br>Electrical Intermediate Metal Conduit Steel |
| Underwriters Laboratories | Standard 651<br>Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings |
| Underwriters Laboratories | Standard 651A<br>Type EB and A Rigid PVC Conduit and HDPE Conduit |

## END OF ITEM L-110

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# ITEM L-115 ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

## DESCRIPTION

**115-1.1** This item shall consist of electrical manholes and junction structures (hand holes, pull boxes, junction cans, etc.) installed per this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the RPR. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the RPR including removal of existing manholes and junction structures as shown on the plans.

## EQUIPMENT AND MATERIALS

**115-2.1 General.**

**a.** All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the RPR.

**b.** Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the RPR) and replaced with materials that comply with these specifications at the Contractor's cost.

**c.** All materials and equipment used to construct this item shall be submitted to the RPR for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

**d.** The data submitted shall be sufficient, in the opinion of the RPR, to determine compliance with the plans and specifications**.** The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section or electronically submitted in pdf format, tabbed by specification section. The RPR reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

**e.** All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

**115-2.2 Concrete structures.** Concrete shall be proportioned, placed, and cured per Item P-610, Concrete for Miscellaneous Structures. Cast-in-place concrete structures shall be as shown on the plans.

**115-2.3 Precast concrete structures.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or another engineer approved third party certification program. Provide precast concrete structures where shown on the plans.

Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand lb heavy aircraft loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown on the plans.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the RPR shall be submitted by the Contractor to allow for a full evaluation by the RPR. The RPR shall review per the process defined in the General Provisions.

**115-2.4 Junction boxes.** Junction boxes shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) airport light bases that are encased in concrete. The light bases shall have a L-894 blank cover, gasket, and stainless steel hardware. All bolts, studs, nuts, lock washers, and other similar fasteners used for the light fixture assemblies must be fabricated from 316L (equivalent to EN 1.4404), 18-8, 410, or 416 stainless steel. If 18-8, 410, or 416 stainless steel is utilized it shall be passivated and be free from any discoloration. Covers shall be 3/8-inch (9-mm) thickness for L-867 and 3/4-inch (19-mm) thickness for L-868. All junction boxes shall be provided with both internal and external ground lugs.

**115-2.5 Mortar.** The mortar shall be composed of one part of cement and two parts of mortar sand, by volume. The cement shall be per the requirements in ASTM C150, Type I. The sand shall be per the requirements in ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15% of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C206. Water shall be potable, reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

**115-2.6 Concrete.** All concrete used in structures shall conform to the requirements of Item P-610, Concrete for Miscellaneous Structures.

**115-2.7 Frames and covers.** The frames shall conform to one of the following requirements:

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|---|---|
| **a.** ASTM A48 | Gray iron castings |
| **b.** ASTM A47 | Malleable iron castings |
| **c.** ASTM A27 | Steel castings |
| **d.** ASTM A283, Grade D | Structural steel for grates and frames |
| **e.** ASTM A536 | Ductile iron castings |
| **f.** ASTM A897 | Austempered ductile iron castings |

All castings specified shall withstand a maximum tire pressure of 167 psi and maximum load of 96,800 lbs per tire.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word “ELECTRIC” or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

Each manhole shall be provided with a “DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER” safety warning sign as detailed in the Contract Documents and in accordance with OSHA 1910.146 (c)(2).

**115-2.8 Ladders.** Ladders, if specified, shall be galvanized steel or as shown on the plans.

**115-2.9 Reinforcing steel.** All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

**115-2.10 Bedding/special backfill.** Bedding or special backfill shall be as shown on the plans.

**115-2.11 Flowable backfill.** Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

**115-2.12 Cable trays.** Cable trays shall be of galvanized steel. Cable trays shall be located as shown on the plans.

**115-2.13 Plastic conduit.** Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

**115-2.14 Conduit terminators.** Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

**115-2.15 Pulling-in irons.** Pulling-in irons shall be manufactured with 7/8-inch (22 mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2-inch (12 mm) diameter with an ultimate strength of 270,000 psi (1862 MPa)). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

**115-2.16 Ground rods.** Ground rods shall be one piece, copper clad steel**.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet (2.4 m) long nor less than 5/8 inch (16 mm) in diameter.

## CONSTRUCTION METHODS

**115-3.1 Unclassified excavation.** It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the RPR without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the RPR. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to Item L-115. Dewatering necessary for structure installation and erosion per federal, state, and local requirements is incidental to Item L-115.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the RPR. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the RPR. Structures shall be placed after the RPR has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 inches (150 mm) of sand or a material approved by the RPR as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

**115-3.2 Concrete structures.** Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the RPR before the concrete is placed.

**115-3.3 Precast unit installations.** Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

**115-3.4 Placement and treatment of castings, frames and fittings.** All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the RPR and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written approval is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the RPR and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

**115-3.5 Installation of ladders.** Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

**115-3.6 Removal of sheeting and bracing.** In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches (150 mm) of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The RPR may direct the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

**115-3.7 Backfilling.** After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches (150 mm) in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the RPR.

Backfill shall not be placed against any structure until approval is given by the RPR. In the case of concrete, such approval shall not be given until tests made by the laboratory under supervision of the RPR establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the RPR may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

**115-3.8 Connection of duct banks.** To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

**115-3.9 Grounding.** A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches (150 mm) above the floor. The ground rod shall be installed within one foot (30 cm) of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4-inch (100 mm) diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of one foot (30 cm) above the floor of the structure and separate

from other cables. No. 2 American wire gauge (AWG) bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. If an exothermic weld is not possible, connections to the grounding bus shall be made by using connectors approved for direct burial in soil or concrete per UL 467. Hardware connections may be mechanical, using a lug designed for that purpose.

**115-3.10 Cleanup and repair.** After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound per MIL-P-21035. Surfaces shall be prepared and compound applied per the manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

**115-3.11 Restoration.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective Item L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

Following restoration of all trenching near airport movement surfaces, the Contractor shall thoroughly visually inspect the area for foreign object debris (FOD), and remove any such FOD that is found. This FOD inspection and removal shall be considered incidental to the pay item of which it is a component part.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

**115-3.12 Inspection.** Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test per American National Standards Institute / Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

**115-3.13 Manhole elevation adjustments.** The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise or lower the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. The Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the plans.

**115-3.14 Duct extension to existing ducts.** Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

## METHOD OF MEASUREMENT

**115-4.1** Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following items shall be included in the price of each unit: All required excavation and dewatering; sheeting and bracing; all required backfilling with on-site materials; restoration of all surfaces and finished grading and turfing; all required connections; temporary cables and connections; and ground rod testing

**115-4.2 Manhole elevation adjustments** shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.

## BASIS OF PAYMENT

**115-5.1** The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

**115-5.2** Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the RPR.

Payment will be made under:

| | |
|---|---|
| Item L-115-5.1 | Electrical Handhole – per each |
| Item L-115-5.2 | Electrical Manhole - per each |
| Item L-115-5.3 | Heavy Duty Quazite Pull Box – per each |

## REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

American National Standards Institute / Insulated Cable Engineers Association (ANSI/ICEA)

| | |
|---|---|
| ANSI/IEEE STD 81 | IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System |

Advisory Circular (AC)

| | |
|---|---|
| AC 150/5345-7 | Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits |
| AC 150/5345-26 | Specification for L-823 Plug and Receptacle, Cable Connectors |
| AC 150/5345-42 | Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories |
| AC 150/5340-30 | Design and Installation Details for Airport Visual Aids |
| AC 150/5345-53 | Airport Lighting Equipment Certification Program |

Commercial Item Description (CID)

| | |
|---|---|
| A-A 59544 | Cable and Wire, Electrical (Power, Fixed Installation) |

ASTM International (ASTM)

| | |
|---|---|
| ASTM A27 | Standard Specification for Steel Castings, Carbon, for General Application |
| ASTM A47 | Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A48 | Standard Specification for Gray Iron Castings |
| ASTM A123 | Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A283 | Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates |
| ASTM A536 | Standard Specification for Ductile Iron Castings |
| ASTM A615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A897 | Standard Specification for Austempered Ductile Iron Castings |
| ASTM C144 | Standard Specification for Aggregate for Masonry Mortar |
| ASTM C150 | Standard Specification for Portland Cement |
| ASTM C206 | Standard Specification for Finishing Hydrated Lime |

FAA Engineering Brief (EB)

| | |
|---|---|
| EB #83 | In Pavement Light Fixture Bolts |

Mil Spec

| | |
|---|---|
| MIL-P-21035 | Paint High Zinc Dust Content, Galvanizing Repair |

National Fire Protection Association (NFPA)

| | |
|---|---|
| NFPA-70 | National Electrical Code (NEC) |

## END OF ITEM L-115

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# SECTION 01143 – AIRPORT PROJECT WORK PROCEDURES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1. Refer also to Section 01100 “Summary”;
2. Refer also to Phasing and Staging Plans in the drawings;

### 1.2 INTRODUCTION – AIRPORT OPERATIONS

A. The safety of the Airport patrons and personnel and of the Contractor’s personnel is paramount throughout construction. Except where stricter requirements are indicated, the Contractor shall follow the safety guidelines referenced in the Federal Aviation Administration (FAA) [www.faa.gov] Advisory Circular (AC) No. 150/5370-2G, latest edition, “Operational Safety on Airports During Construction”.

B. This project may include Contractor operations within active Air Operations Areas (AOA). The Airport will conduct normal aircraft operations during the course of this project, subject to certain restrictions called out in this section or elsewhere in the specifications. Therefore, to provide for the security and safety of Airport users and the Contractor’s forces, as well as to minimize interruptions to aircraft operations, the Contractor shall limit his work within the areas designated and conduct his operations as specified.

C. This project may include work in and around Transportation Security Administration (TSA) [www.tsa.gov] work and office areas. Work shall be installed, and be conducted, in accordance with latest TSA guidelines and in coordination with the local Federal Security Director’s office and the local TSA representative. The current "Recommended Security Guidelines for Airport Planning, Design, and Construction" were revised June 15, 2006 and are available through the TSA website.

D. Unauthorized crossing of the AOA is prohibited.

1. Any fines or assessments levied against the Sponsor (Owner) as a result of intrusions in the AOA or other violations by the Contractor’s personnel or those of his subcontractors and suppliers will be passed on to the Contractor and assessed against the Contract Amount on the next Application for Payment.
2. In addition to any fines assessed to the individual and the Sponsor, the Contractor will be subject to a fine per incident, assessed by the Sponsor.

    a. For the first incident, the individual and firm will be fined $2,500.
    b. For the second incident, the individual and firm will be fined $5,000.
    c. For the third incident, the individual, and possibly the associated firm, may be prohibited from the Secured Area, from the Work area, or from the Airport property, at the sole discretion of the Sponsor.

E. Construction Scheduling and Coordination: The Work will be conducted so as to provide the least possible interference with the Owner’s daily operations. Prior to commencing Work on-site, the Contractor shall submit, and secure approval from the Owner, a complete schedule for the project, identifying any expected periods of potential conflict.

F. Coordinate Construction Activities with Airport Operations and Security Plan:

1. Provide and/or secure the following:

a. Safety Plan Report
b. Quality Assurance Plan Report
c. Security badges/training

2. Reports under this heading shall be prepared in compliance with Airport Operations Department requirements.

G. Contractor may contact the Airport Engineer for requirements and clarifications related to this topic.

## 1.3 AIRPORT SAFETY

A. Contractor shall obtain, have knowledge of, and incorporate the following safety provisions into the construction project:

1. Operational Safety on Airports during Construction – AC-150/5370-2G, latest edition, (attached as Appendix 1).
2. Airport Safety Self-Inspection – AC-150/5200, latest edition.
3. Painting, Marking, and Lighting of Vehicles Used on an Airport – AC 150/5210, latest edition.
4. Consideration of Improvement of Airport Safety – FAR, PART 139.

B. Contractor shall comply with all Airport security regulations that may be established to protect airport operations.

1. Additional notes on the Phasing and Staging drawings and in the general requirements sections of these Contract Documents provide a level of safety and security requirements and guidelines.
2. The Contractor shall incorporate the Airport guidelines and requirements into his Construction Safety and Security Plan, and obtain the Owner's approval in advance of mobilizing Contractor's forces on the Airport premises.
3. Failure to comply with the Contractor's Safety and Security Plan, or violation of any Airport safety and security regulations and protocols, will result in disciplinary action. At a minimum, violations will result in temporary restriction of an individual's access to secure areas of the Airport. Disciplinary actions may, as relates to the type and nature of the violation, and at the Airport's sole discretion, include:

a. Verbal reprimand and temporary revocation of access privileges
b. Temporary revocation of access privileges and mandatory re-training in Security Class and Airport Safety and Security procedures
c. Permanent restriction of access privileges
d. Permanent loss of access privileges
e. Restriction from worksite
f. Restriction and removal from Airport property(ies)
g. Fines, as defined elsewhere in this document or in the security plan

C. All actions of the Contractor's employees, subcontractors and suppliers are the sole responsibility of the Contractor. All employees, subcontractors and suppliers must be educated regarding related work and the safety requirements of the aircraft operations area and public safety adjacent to the construction area.

D. Observe and/or follow all safety related instructions by any Federal Aviation Administration (FAA), Transportation Security Administration, and Airport personnel at all times.

1. In case of emergency, the Contractor shall make every effort to remove the equipment and personnel from affected area(s) and abide by decisions made by the Owner or his/her representative.

    a. To the best of his ability, the Contractor shall immediately comply with directives from representatives of the FAA and Transportation Security Administration. Contractor will then promptly notify first the designated Airport Operations representative and second the Owner's project representative of the incident.
    b. See General Conditions and other parts of this Section for additional information in case of emergencies and other unforeseeable conditions beyond the Control of the Contractor or the Owner, which may include acts of God or the public enemy, acts of government, hurricanes, fires, floods, or safety and security incidences and changes in national transportation safety and security procedures.

E. The Contractor shall cooperate with the airport users, through the Owner, in scheduling his or her operations to provide adequate clearances for safe access, circulation and exit of passengers; loading and unloading of baggage, and maneuvering, taxiing, and parking of aircraft and ground equipment.

F. Work will be carried on in such a manner as to leave the portion of the building open to airport users free from hazards at all times.

1. All walk surfaces shall be kept clean and free of dirt, stone, and debris.
2. Mud tracked into portions of the building that are in use shall be cleaned immediately.
3. Waste and loose material capable of causing harm to the public shall not be tolerated.

G. Vehicular Markings: Contractor vehicles and equipment shall be marked with checkered flags and lighted with flashing beacons to comply with requirements of FAA AC 150/5210, latest edition.

H. Taxiway Safety Zones:

1. Limitations: When necessary to accomplish construction in areas adjacent to taxiways, the construction equipment, vehicles, and men are authorized to operate without interruption within the project limits, except within the following areas and as specified otherwise:

    a. Distance from active taxiway or apron taxilane centerline: Within 129.5 feet.

2. Request for Facility Closures: Construction activities on taxiways or within the above-restricted areas shall only be performed at times when the taxiways are closed to aircraft. Closure of a taxiway or any portion thereof must be requested in writing by the Contractor through the Engineer. This request must indicate the areas needed and a schedule of operations and time(s) required for operations within the area. The Owner reserves the right, however, to shift any approved closure periods to alleviate aircraft congestion or when inclement weather conditions dictate.

3. Equipment Operation Restrictions: Contractor may be permitted to operate trenching machines and other equipment in Taxiway Safety Zones provided all of the following conditions are satisfied:

    a. The equipment operator and/or crew foreman monitors the ATC ground frequency continuously, using a two-way radio transceiver.
    b. All equipment shall be cleared from the Taxiway Safety Zones during aircraft operations (landings, take-offs, and taxiing).
    c. All equipment within the Taxiway Safety Zones is manned and being used. No unnecessary or parked equipment will be allowed within the Taxiway Safety Zones.
    d. All excavated trenches and holes shall be backfilled, tamped and leveled to match existing grades before workmen leave the site at the end of each workday.

4. Stockpiles: Stockpiled materials shall not be permitted within the taxiway safety zones.

5. Grading Requirements: All construction within a restricted area shall be performed in such a manner that, at the end of the closure period, it will leave the safety area with no abrupt grade changes and with no trenches with depth or width greater than 3".

I. Obstructions to Navigation:

1. Violation of Safety Zone Surfaces: Penetration of equipment, vehicles, materials, or men into the safety zones and approach surfaces requires the preparation and distribution of Notices of Airmen (NOTAMs) in advance to the actual penetration.

2. Scheduling: When part of the work in this project is in violation of FAR Part 77, the clearance distance requirements from runway and taxiway edges shall be incorporated into the construction sequence schedule. At no time shall the construction limits of the area under construction violate the safety zones without prior notification to and approval by the Architect / Engineer and the Airport Engineer.

J. Coordination and Communication: Work within and adjacent to active AOAs shall be coordinated with the Owner prior to commencement of the activity. Work crews in these areas shall be accompanied by the construction superintendent who shall be in constant radio contact with ATC.

K. Safety and security can be discussed with the Contractor or his or her representative at the Pre-Construction Conference and at progress meetings at the job site.

## 1.4 AIRPORT SECURITY

A. Secured Area Requirements: As part of the Airport Security Plan, the Contractor will be required to adhere to all FAA and TSA security requirements and all construction personnel working in, or having access to, secure areas (AOA side of the Secured Area, see Phasing and Staging Plans for limits) will be required to obtain and wear badges issued by the Owner and comply with provisions of the Airport Security Plan.

1. Badges will be required for certain construction personnel. The Contractor's superintendent and supervisors, all approved equipment escort personnel, and other select personnel shall be trained, certified and badged for operations within the Secured Area as defined with the current approved Airport Security Plan.

2. Obtain necessary clearances and identification badges for construction personnel through the Airport Operations Department (See Special Conditions, "Airport Security Provisions"). The badges shall be returned at project completion.

3. Applications for clearance check and other required forms should be turned into Airport Operations. A photo identification badge will be issued for each approved application.

   a. There will be a processing fee of Forty-One Dollars ($41.00) for fingerprint and background check prior to issuing each initial badge.
   b. The badge remains property of the Owner. There is a Twelve Dollar ($12.00) charge for the initial badge itself.
   c. There will be a Forty Dollar ($40.00) nonrefundable replacement fee for lost badges.
   d. A non-refundable fee of Seventy-Five Dollars ($75.00) fee will be assessed if a badge holder does not return badge at the completion of the project, or upon request of Airport Operations, or if a badge holder fails to report a lost badge in a timely manner.

4. Each badge holder will be required to comply with the security rules and regulations of St. Pete~Clearwater International Airport.

    a. The Airport could suffer severe fines or penalties as a result of security violations.
    b. The Contractor will be responsible for these fines or penalties for any security violations that are his responsibility.
    c. In addition to fines assessed by the FAA or TSA for security violations, the Contractor, and the responsible individual, will be assessed a fine for each violation, as described elsewhere in this Section.

B. The Contractor shall provide security within the construction area and shall keep all unauthorized personnel out.

C. Contractor should confine all construction personnel to within the construction limits during each phase of the work.

D. Contractor security measures will be discussed and reviewed at the Pre-Construction Conference.

1.5 CONSTRUCTION SAFETY REQUIREMENTS:

A. General Safety and Accident Prevention: The Contractor shall comply with all applicable federal, state, and local laws, ordinances, and regulations governing safety, health, and sanitation; shall provide barricades; and shall take any other needed actions, on his or her own responsibility, that are reasonably necessary to protect the life and health of employees on the job, the safety of airport users, and the safety of moving and parked aircraft, and other property during the performance of the work.

1. Safety Officer: The Contractor is required to designate a Safety Officer who will be the liaison between the Contractor, the Architect/Engineer and the Owner in all safety related matters for the duration of the project. The Safety Officer shall be on call 24 hours per day for emergency maintenance of airport hazard lighting, barricades, and other safety features.

    a. The Safety Officer’s duties shall include accident prevention.

B. Portions of the Airport shall be occupied during construction. The Contractor shall comply with the following life safety issues. Failure to list all life safety issues does not relieve the Contractors from complying with federal, state, and local codes, the contractual agreement between the Contractor and Owner, and other governing bodies, which have jurisdiction on this project. The following are interim life safety code issues which are specific to this project and must be addressed:

1. Insure all exits provide free and unobstructed egress. The Airport Engineer shall receive written notification and shall respond with approval if alternative exits must be designated.
2. Ensure fire alarm, detection and suppression systems are not impaired. A temporary, but equivalent, system shall be provided, installed and tested prior to any existing fire system being impaired.
3. Ensure temporary construction partitions are smoke tight and built of non-combustible materials. The locations of partitions shall be coordinated with the Airport Engineer. Surfaces exposed to public view shall be gypsum board, taped, and painted. Construction side surfaces may be gypsum board or fire treated plywood at Contractor’s option.
4. Provide temporary walkway enclosures as required when access is needed thru a construction area. Enclosures shall be designed by a licensed structural Engineer for the potential construction loads in that area.
5. Smoking shall be prohibited in all areas of the building. Only in designated areas outside the airport shall smoking be allowed. No smoking within or adjacent to the Airport Apron areas will be allowed.

6. Develop and enforce storage, housekeeping and debris removal procedures that reduce the flammable and combustible fire load to the lowest level necessary for daily operations.
7. Secure all tools and construction materials during breaks and non-construction hours.

C. Protection of Utilities: The Contractor shall be responsible for field marking and protecting all utilities within the construction limits.

D. Storage of Equipment, Vehicles, and Materials: All equipment, vehicles, and materials must be stored in the designated storage or staging area or in areas acceptable to the Architect / Engineer.

E. Limitations on Construction Methods:

1. No open flames or burning will be allowed on Airport property. Burning of debris will not be allowed on airport property
2. Stockpiled material shall be constrained in a manner to prevent displacement by jet blast, propeller blast, or wind.

F. Prior to commencing the work, Contractor shall obtain all necessary permits and approvals, including building construction permits, required for the project.

G. Contractor to submit a safety security plan for approval within ten days of receipt of Letter of Intent to Award, but in no case later than the Pre-Construction Conference.

## 1.6 PHASING AND SEQUENCING

A. The Contractor shall schedule his or her work activities in accordance with requirements of the Phasing Plans, and these Specifications unless otherwise approved by the Owner.

B. Existing easements to other properties shall be maintained at all times. Areas outside the project limits are designated as restricted areas. The Contractor’s forces are prohibited from entering restricted areas at any time, unless specifically authorized by the Airport Operations office.

1. Construction stakeout shall be performed by Contractor in accordance with the specifications. It shall be the responsibility of the Contractor to provide all measurements that may be required to lay out the construction. Field verification and survey of the existing building tie-in and dimensions will be required by the Contractor prior to the start of all construction and each phase of work.

C. Contractor shall be responsible for visiting the site to become familiar with the existing conditions. The documents shall serve to aid the Contractor in his evaluation of the sequences and extents of construction; but shall not be held to be all-inclusive. Any apparent conflicts or deficiencies must be submitted to the Architect, in writing, prior to bidding.

D. Owner/Tenants/Vendors shall be responsible for the removal of their furnishings and equipment unless noted otherwise.

E. Contractor shall be responsible for relocation of fixed furnishings, seating, airport equipment, vending equipment, concession stands, millwork, and security equipment necessary for the progress of the Work. Coordinate requirements with Owner or Tenant as applicable.

1.7 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to staging areas, and areas identified for each phase of construction elsewhere in the Construction Documents.

a. Restricted Areas: Secure Identification Display Areas, Secured Area, and Aircraft Operations Area:

1) Access to some areas of the Project Work Area is restricted to cleared personnel. Contractor shall be responsible for the performance of his own forces, of all subcontractors and subcontractors' forces, and suppliers.
2) Contractor is responsible for making himself and his forces on site aware of the Airport Security Program as it relates to access to the Airport Operations Area.
3) Perform work in a manner so as to limit construction activities in restricted areas of the Airport. Contractor's approved Superintendent shall be present for any construction activity that is expected to occur in the Secured Area.

2. The Owner will endeavor to cooperate with the Contractor's operations when the Contractor has notified the Airport Engineer in advance of need for changes in operations in order to accommodate construction operations. Conduct the work so as to cause the least interference with the Owner's operations.

3. The following existing facilities may not be used by construction personnel:

a. Public elevators.
b. Toilet facilities.
c. Parking lots, except as designated in the staging plans.
d. Public telephones
e. Public waiting areas

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

a. Schedule deliveries to minimize use of driveways and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
c. Delivery vehicles, construction vehicles and other construction related hauling vehicles are restricted to the hauling/travel routes identified on the Site Phasing Plan, unless otherwise authorized, in writing, by the Airport Engineer.
d. The area immediately adjacent to the Area of Work is limited. Coordinate transportation of workers and equipment from the Staging Area to this area in order to limit the number of vehicles present. Limit total number of vehicles in this area to the space available, and as approved in advance by the Airport Engineer. Only authorized work vehicles, as described elsewhere in this document, will be allowed access to the Secured Area. No personal vehicles will be allowed in the staging areas within the Secured Area.
e. Storage areas will be available on site.
f. Tools and materials shall remain in visual control of construction personnel and shall not be left unattended in Public Areas of the Airport.

5. Signs: Provide signs adequate to direct visitors. Do not install, or allow to be installed, signs other than specified sign(s) and signs identifying the principal entities involved in the project.

B. Use of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

C. Emergency Preparedness / Special Event Conditions: The Contractor shall fully participate with the County in reasonable measures to protect the general public, the County and the Airport, their employees, the Contractor and his employees, and his forces, equipment, and materials from damages from unforeseeable causes beyond the control of the Owner or the Contractor, including but not limited to: unusual weather events, acts of God, acts of public enemies, acts of government, fires, floods, discovery of pre-existing hazardous materials or hazardous conditions, epidemics, quarantine or public-health regulations, and strikes or lockouts.

1. In the event of an emergency affecting the safety or security of the public, Airport tenants, Airport employees, Contractor or subcontractor employees, the Project, other property or individuals, then the Contractor, without special instruction or authorization, shall act to prevent and reduce injury, damage, or loss.

    a. Upon observation of conditions, acts or events indicating risk to safety or security anywhere on Airport property, Contractor shall immediately notify Airport Operations and Airport Engineer.

2. The Contractor and representatives of primary subcontractors, to include at a minimum the Superintendent, Safety Coordinator, and Security Coordinator, shall attend and take part in bi-annual emergency preparedness planning meetings organized by the Airport.

3. In the event of foreseeable (at least 24-hours advance warning) uncontrollable conditions that may impact the Airport (e.g., approaching hurricane), the Contractor is responsible for securing the Project Area to reduce risk of damage to persons or property, to the satisfaction of the Owner. Upon notice from the Airport Engineer or other authority having jurisdiction of impending hazardous conditions, the Contractor shall:

    a. Enclose any in-progress openings in the building envelope with weather-proof temporary partitions.
    b. Cover exposed substrates or incomplete exterior finishes securely with anchored water-resistant coverings.
    c. Secure unused materials in containers and/or trailers and remove from areas in, on, or adjacent to construction or existing buildings.
    d. Remove all equipment or materials that are likely to become air- or water-borne, to include staging materials and temporary facilities, from, on or adjacent to the AOA.
    e. Remove cranes, hoists, and other mobile equipment over ten feet tall from the site, or to covered storage, if allowed by the Airport Engineer.
    f. Remove all non-essential vehicles from the Site, and secure off-site under Contractor’s care and control.
    g. When practical, completely demobilize staging area on the Airside of permanent fences and relocate to other staging areas on the Landside, non-secure side of Airport buildings and security fence.
    h. When practical, remove equipment and materials to secured storage off-site, approved per other parts of these specifications.
    i. Cover, secure, and anchor any equipment and materials in the non-secure staging area that cannot practically be relocated to secured storage off-site.
    j. Secure the Work and Site as is most practicable, and in the best interests of the public, the Project, the Owner, and Contractor.
    k. Provide the Airport Engineer with emergency contact information for key personnel.
    l. Evacuate non-essential personnel to safer locations.

4. Contractor is fully responsible for the safety and security of the Project throughout Construction. In any special event, should the Contractor fail to remove forces, equipment, and materials under his control from the Owner property, or to secure the same and the Work to the satisfaction of the Airport Engineer, and in the opinion of the Airport Engineer those forces equipment, or materials shall be at risk of injury, damage or loss, or of causing injury, damage, or loss to the Owner or others; then the Owner may, or may not, choose to remove, relocate, or secure the Work by whatever means the Owner deems in the best interest of the Owner and the Project.

    a. The Contractor agrees in a special event that he has abandoned any property not secured to the satisfaction of the Airport Engineer.
    b. Should the Owner be required to secure items under the control of the Contractor, the Contractor shall reimburse the Owner for actual costs incurred in securing the Work, to include, but not limited to, labor, oversight, use of equipment, rental of equipment, cost of fuels, storage fees, material, utilities, and incidentals.
    c. The Owner assumes no responsibility for damage or loss of Contractor property, equipment, materials or parts of the Work not secured by the Contractor, or necessitated to be secured or relocated in the interests of public safety or security.

D. Cleanliness of Site: Contractor shall be responsible for keeping aircraft operations areas, movement areas, ground service routes, work open to or visible from public areas, the Airport Terminal and the Public Areas immediately adjacent to Project Work Areas and temporary partition access points within Public Areas, tenant operations areas, work areas used or accessed by others, haul route, and staging areas in an orderly and clean condition.

1. Areas on or adjacent to aircraft operations shall be kept clean and free of loose debris that may pose a hindrance to airport operations. Contractor shall police area on a regular basis, provide adequate containers for anticipated debris, and remove loose debris and containers to storage away from aircraft operations area and security fence on a more-than-daily basis. Further requirements are noted elsewhere in the contract documents, the drawings and project manual.

2. Provide 5’-0” x 5’-0” walk-off matts at Project Work Area access-doors at both the Public and the Project Work Area side of the doorway.

3. Inspect Public Areas (adjacent to Project Work Areas) with the Airport designated representative(s) to ensure the Public Areas are cleaned satisfactory on a daily basis. Clean Public Areas that are unsatisfactory to the Airport prior to daily departure of construction personnel.

## 1.8 OCCUPANCY REQUIREMENTS

A. Owner Occupancy: Allow for Owner occupancy of site and use by the public.

B. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner’s operations.

C. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.

2. Obtain a temporary Certificate of Occupancy from Authorities Having Jurisdiction before Owner occupancy for interim Owner occupied phases and a permanent Certificate of Occupancy for the final complete project.
3. Before partial Owner occupancy, mechanical, electrical systems and life safety systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

## 1.9 COORDINATION WITH DAILY OPERATIONS

A. Occupied areas include all areas in which the Owner's regular operations will be going on or to which the Owner requires access during the construction period, whether conducted by the Owner or his tenants, clientele, or the public.

B. On-Site Work Hours: **Construction related activities, in general, shall proceed during normal working hours, unless the work will interfere with operating procedures of the Airport.** When this interference occurs, the **Contractor shall arrange his activities and work schedule to be performed during non-operating hours of the area of the Airport affected**. Some areas of the Airport are in operation for fewer hours each day than the overall operating hours, and the Contractor shall have the option of working those areas which are not in operation when the construction activities cause neither interference nor safety or security problems to the users of the Airport. Contractor may, upon approval of the Owner, choose to conduct construction activities during off hours. Owner requires that an authorized representative of Airport Operations be present on-Airport during Contractor Activities. Work in public areas, and work impacting airline or tenant operations areas, shall be coordinated with the Airport and respective tenants not less than thirty (30) days in advance of anticipated work in those areas.

1. Normal Operating Hours: The Airport is generally in operation between the hours of 5:00 am and 12:00 (midnight), seven days per week. Precise work hours shall be coordinated with Airport at Pre-Construction Conference, and may be adjusted, if needed, at monthly meetings thereafter.

    a. Peak Passenger Activity Hours: Peak activity, based on recent historical records, generally occurs between 5:00 am and 10:00 pm; times are subject to change, based on scheduled airport and airline activity. Contractor shall arrange activities to have minimal impact on the traveling public and airport and airline operations.

2. Off-Peak Hours: Off-Peak hours are generally defined between as being between 12:00 (midnight) and 4:00 am in most areas. Clean up and demobilization may occur between 4:00 a.m. and 5:00 a.m.

    a. Contractor shall limit and restrict Work during off-hours. Contractor shall coordinate with Airport not less than fifteen days in advance of performing any off-hours work, and shall be responsible for reimbursing the Owner for additional costs incurred to provide staff during non-normal hours.

3. Coordination with Aircraft Operations: Contractor shall coordinate his activities and work to minimize impacts to the traveling public, Airport, and airline operations. Activity at the Airport is traditionally seasonal, and more passengers are anticipated during the winter and spring.

    a. A copy of a sample weekly flight schedule will be provided at the Pre-Construction conference for Contractor's information only and is subject to change.

    b. The Owner will coordinate with the Contractor at least monthly during regularly scheduled coordination meetings, regarding known airline flight schedule changes one month ahead.

C. Limit access through occupied areas to those days and times which the Airport Engineer approves.

D. The Contractor shall review the phasing plans and shall submit his plan for providing safe and secure passageway for users of the Airport during construction activities. Any access or egress routes which are required exits in accordance with applicable building codes shall be maintained at all times during the construction of any given area.

E. When the following must be modified, provide alternate facilities acceptable to the Airport Engineer:

1. Entrances which must remain open.
2. Doors and gates which are part of the Airport's security (Secured Area) demarcation.
3. Utilities which must remain in operation.
4. Informational signage to direct the movement of passengers.

F. Scheduling: Contractor shall review and coordinate Construction Schedule with Owner.

1. Submit a comprehensive preliminary construction schedule for review at the Pre-Construction Conference. Refer to other sections of these general requirements for additional information.
2. Changes to the approved construction schedule will not be allowed unless approved by the Airport Engineer in writing. A construction schedule with project sequencing and coordination timetables for construction adjacent to or within aircraft operation areas must be approved before any work commences.
3. Changes to Security Operations: Notify Architect / Engineer and Airport Engineer in writing at least forty-five calendar days in advance of any proposed changes affecting the Secured Area, including any changes to the security fence, any gates or doors opening to the Secured Area, access control devices at doors and gates on the line of demarcation, modifications to staging areas in the Secured Area, modifications to Security Operations such as using a guard at a gate rather than existing access control. Proposed changes, including temporary changes, to the Airport Security Plan must be approved and filed with the authorizing agencies not less than thirty days prior to the change taking affect. Contractor shall be liable for any delays in prosecuting his or her work resulting from failure to provide sufficient notice.
4. Notify Airport Engineer and Architect / Engineer at least seven days in advance of any proposed changes to the construction schedule for approval.
5. Notify Airport Engineer and Architect / Engineer at least ten calendar days in advance of mobilizing to the project staging area.
6. At times and days to be determined at the Pre-Construction Conference, monthly meetings shall be held involving the Contractor's superintendent, the Architect / Engineer and the Airport Engineer; weekly meetings may be held involving the construction superintendent and the Owner's designate representative.
7. The Contractor shall be responsible for informing in writing the Airport of the construction schedule for the approaching two weeks' construction activity.
8. All subcontractors shall supply the above information to the Contractor for inclusion in their report. Any storage of materials, access or egress problems, traffic flow or normal airport operations which are to be affected must be protected and/or agreed upon by the Airport Engineer. All costs shall be incurred by the Contractor.

## 1.10 UTILITIES

A. Utilities are located within the construction area. Contractor shall coordinate with Owner and Architect / Engineer to identify utilities. Contractor shall be responsible for contacting utility owners and locating all existing utilities within the work area. Contractor shall be responsible for costs associated with utility location, protection, and for required repairs due to failure to comply with these requirements.

B. Information concerning underground utilities and service lines may be obtained from the utility companies, Owner, FAA, or the national weather service. The Owner and the Architect do not guarantee

their accuracy. The Contractor is advised to determine the exact locations from the available sources of information, or provide his own means of detection.

1. Agencies / utility companies with service on the Airport are as follows:

    a. Federal Aviation Administration
    b. National Weather Service
    c. Gas, Electric
    d. Domestic Water
    e. Sewer
    f. Cable Television
    g. Telephone Service
    h. Airport Data, Security and PA System

C. Contractor shall notify Airport personnel, utility companies, FAA personnel, and weather bureau personnel before excavating in any area.

D. In all construction areas, all FAA cables will be marked by FAA prior to construction. Contractor is to protect cables during construction. Contractor shall notify FAA supervisor in advance of construction activity to allow the FAA sufficient time to locate and mark existing field cable and to avoid unscheduled facility outages. Any FAA equipment/cable that is damaged by the Contractor shall be repaired as approved by the FAA supervisor / representative. All cable splice/repairs shall meet FAA specifications and be accomplished to the satisfaction of the FAA representative. Qualified workmen regularly engaged in that type of work shall perform all cable work. If an existing cable cannot be repaired to the satisfaction of the FAA, new cable of like kind shall be installed.

E. Maintain existing surface and pipe storm drainage, unless otherwise noted.

## PART 2 - PRODUCTS

### 2.1 BARRICADES

A. Barricades shall be constructed and installed as described in other sections of the specifications and as shown on the drawings, and in accordance with the current version of AC No. 150/5370 “Operational Safety on Airports During Construction” and the *Manual on Uniform Traffic Control Devices* (MUTCD).

B. Maintain barricades throughout construction.

1. Inspect barricades in place at least twice daily to ensure correct placement and functional flags and light.
2. Immediately correct any damage or disrepair, or replace barricade.

C. Furnish and maintain all barricades lights.

1. Supply all batteries and lamps for barricade lights necessary for Project.

D. Remove and relocate barricades as directed by the Engineer/Architect and/or the Airport Engineer during construction in accordance with referenced guidelines.

## PART 3 - EXECUTION

### 3.1 COORDINATION

A. The Contractor shall have a general supervisor on the job at all times during construction activity.

B. The Owner will designate a representative who will issue all notices to airmen (NOTAMs) with the Federal Aviation Administration.

C. The Contractor shall furnish the Owner's representative with the necessary information on construction conditions (apron closure, tie-ins to existing movement areas, etc.) so that the Airport can advise flight control to issue NOTAMs in accordance with established criteria.

D. The Contractor shall make reasonable effort to coordinate with separate Contractors working in the same area or adjacent areas. Specific overlap areas are noted elsewhere in the contract documents, the drawings and project manual.

### 3.2 CONTRACTOR OPERATIONS ON SITE

A. The Contractor shall at all times so conduct his or her work as to create no hindrance, hazard, or obstacle to vehicular or aircraft traffic using the airport.

1. The Contractor shall control his or her operations and the operations of his subcontractors and all suppliers so as to provide for the free and unobstructed movement of aircraft in the aircraft operations areas of the airport. This area shall be accessible to the Contractor on a limited basis.
2. Aircraft always have right of way in operating areas.
3. The Contractor shall not enter or encroach upon an aircraft parking area or operational taxiway without first obtaining permission from the Owner or FAA, as allowed under the Security Plan.

B. Damage to aircraft, ground equipment, or facilities resulting from hauling or storage of material or other activities in connection with the execution of the contract work, shall be repaired or replaced by the Contractor in as good or better condition as originally found.

C. All construction traffic shall enter and exit the project area through access points, as shown on the drawings and as directed by the Airport Operations representative. Access to the work: will be via the access routes shown on the plans or as directed by the Airport Engineer.

1. The Contractor shall identify access routes with suitable signs, barricades and similar equipment.
2. Contractor will be responsible for security of construction access gates in accordance with the Airport Security Plan.
3. Contractor to provide temporary gate and fencing at perimeter of project areas as needed, and is to be responsible for security, maintenance, and restoration of areas.
4. Gates to airfield operating areas (AOA) or security identification display areas (SIDA) must be locked at all times or manned at all times by badged employees of the Contractor.

D. Use of Contractor Vehicles on airport property:

1. Contractor's vehicles used on the Airside portion of the premises must be clearly marked.
2. All vehicles operated on existing pavements to remain shall be rubber tired.
3. All vehicles of the Contractor's forces shall be parked in designated areas only.
4. In the event the Contractor must service his equipment on airport property, all oil and fluids removed from the equipment must be collected and disposed of in accordance with local, state and

federal environmental laws. If a hazardous or regulated material is spilled, it must be cleaned up by the Contractor and promptly reported to the airport.

E. Haul Route: Existing roads used as part of the haul road shall be restored to their original condition after completion of the project, unless noted otherwise. The Contractor will be responsible for daily clean up operations of debris that may be on the haul road.

1. The existing Airport pavements, access roads, and haul routes may not be capable of supporting certain types of construction equipment. Prior to bidding, the Contractor shall fully satisfy himself or herself as to the ability of the existing airport pavements to satisfactorily sustain the type of equipment he plans to use. Contractor shall size the equipment used for construction accordingly. As part of the Work, the Contractor shall repair any damage caused by hauling or any other construction activity to existing pavement.
2. It is of specific importance that all aircraft operating areas be kept free of debris due to potential aircraft damage. The Contractor shall police the construction and adjacent site area regularly to assure that no debris creates an endangerment to aircraft. Contractor shall maintain these pavements clean throughout the project.
3. Except where designated on plans or as authorized by Architect or Airport Engineer, Contractor will not be allowed to use any of the existing runways, taxiways, or apron as part of the haul road.
4. The Contractor shall restore any project access route, staging area, waste area, stockpile area and all haul roads to the original condition, including topsoil and seeding, at job completion.

F. The Contractor’s staging area has been shown on the plans for information purposes only. The actual size and location will be determined at the Pre-Construction Conference.

1. All construction material and equipment shall be located and stored in the designated staging area(s) only.
2. The Contractor will be responsible for the daily cleanup and regular disposal of trash and debris created by his work or personnel. Trash and debris must be disposed of offsite.
3. The Contractor will be responsible for the storage and security of his material and equipment and shall erect storage facilities and fencing as necessary. The Contractor’s storage and staging area shall be in the general location(s) shown on drawing.

G. Contractor shall control dust at an acceptable level. The Contractor may be required to keep a water supply at the project site during heavy equipment usage areas.

H. Stockpiled material shall be constrained in a manner to prevent movement resulting from aircraft engine blast or wind.

## 3.3 COMMUNICATIONS AND CONTROLS

A. Contractor shall maintain communication with Airport Operations at all times during construction activity or access in the Aircraft Operations Area (AOA).

1. All access to or through Aircraft Movement Areas shall be by appropriate badged escorting individuals and shall be coordinated in advance with Airport Operations, Airport Engineer, and the Engineer/Architect. Vehicles in the Movement Areas shall maintain open communication with the Superintendent and Airport Operations.

2. Approaching, intruding upon, or crossing the taxiways and runways is strictly prohibited.

B. Contractor shall protect existing runway and taxiway lights, signs, and NAVAIDS.

1. Any unplanned, unapproved, or accidental shutdown or interruption of service to any lighting circuit or navigational aid requires immediate notification to the Airport operations department

and the Architect / Engineer and shall be repaired immediately by the Contractor. The cost of materials and labor required to repair the lighting circuit shall be borne by the Contractor.

C. Safety Devices and Barricades: Existing aprons, taxiways and runways outside the limits of construction shall be separated from construction areas with barricades as shown on the phasing plans and as directed by the Airport Engineer.

1. Place all barricades and temporary markings at locations as directed by the Airport Engineer and the Architect / Engineer. Exact locations will vary depending on aircraft operations, construction schedule and construction operations.
2. Mark and light all open trenches in accordance with FAA AC 150/5210, latest edition.
3. Contractors shall locate and maintain all airfield safety devices. Contractor should provide for daily check of required lights and replacement of batteries to ensure correct operations.

D. When the Contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to accommodate traffic. The Contractor shall furnish, erect and maintain barricades, warning signs, flagmen, and other traffic control devices in reasonable conformity with the *Manual of Uniform Traffic Control Devices* for streets and highways unless otherwise specified herein.

E. If the Contractor is given approval to work at night, he or she shall provide lights at the work site. Type, direction, number and location of lights shall be submitted not less than ten days in advance for review and approval by the Airport Engineer. Where lighting affects the aircraft apron, it shall be accomplished in a manner to create no hindrance to aircraft, aircraft operations, or the aircraft control tower. Upon notification of any conflict, the Contractor shall adjust lighting in the field as directed by the Airport Engineer or the Architect / Engineer.

F. Appropriately mark or light all equipment to be operated on the airside area in accordance with FAA AC 150/5210, latest edition. Maximum height of equipment shall be 35 feet depending on the location within Contractor's work limits shown on safety and sequencing plans unless approved by the FAA, and Airport Engineer. Use of any equipment exceeding this height at any time, will only be during daylight VFR conditions.

G. All vehicles used on the airfield shall meet airport requirements for marking and lighting all equipment.

1. Vehicles shall be marked with rotating yellow beacons and 3 by 3 orange and white flags in accordance with FAA AC 150/5210, latest edition, in addition to company logos and markings identifying each piece of equipment.

a. Advisory Circular may be obtained from the FAA (www.faa.gov).

## 3.4 SECURITY GATES AND FENCING:

A. Responsibility for Security: The Contractor has the responsibility for maintaining control of the access gates or any other entrance to the AOA within the project work area.

1. The Contractor's method of maintaining security shall be set forth in his Security Plan. Deviations or variations from the Contractor's Security Plan must be approved by the Owner, in advance, in writing.
2. Any change, including temporary changes, in operation of existing gates or doors requires advance coordination with the Airport Engineer.

3. The Contractor shall maintain existing gates and access routes in current operation, unless specifically noted otherwise in other parts of the contract documents, drawings, and specifications; or as authorized in writing by the Airport Engineer.
4. The Contractor may utilize a gate guard or install an automatic operated gate controller with limited access with numeric keypad.

## END OF SECTION 01143

# SECTION 999-0000 – UNSPECIFIED WORK (ALLOWANCE)

The work under this Section includes an allowance for any unspecified work that may be associated with the work in this contract or as otherwise identified by the Engineer. Any amount of extra work and/or alternations to this contract charged to the allowance "Unspecified Work" shall be fully documented and approved in writing, in advance, by the Engineer. All work performed under the allowance of "Unspecified Work" shall be completed in accordance with all conditions and requirements of this contract and shall include the work to be done by all necessary subcontractors and/or suppliers.

"Unspecified Work" shall mean the stated fixed sum of money to be used only at the Engineer's specified direction. The particular requirements and items for the allowances will be provided to the Contractor at the appropriate time and shall apply only to additional items over and above those specified/indicated in the plans of this contract.

For equipment under the control of the Contractor through direct ownership, leasing, renting or other method of acquisition not included in the bid, the Contractor shall furnish cost data which may assist the Engineer in the establishment of an equitable rate.

**Time Frame**

When Contractor is requested, in writing by the County, to provide a cost for unspecified work, the Contractor will provide a submittal of the cost to the County within 21 calendar days of receiving written request. After receipt of the Contractor's cost submittal, the County will have 21 calendar days to negotiate, approve or reject the Contractor's cost for proposed work in accordance with the contract specifications. If the County provides to the Contractor written approval of Contractor's cost submittal for proposed unspecified work, then the Contractor may proceed with commencing the unspecified work.

**Basis of Payment**

The work in this Section shall be paid for by a portion of the allowance under "Unspecified Work" in the Schedule of Values of this contract. Use of any portion of this pay item shall require written pre-approval by the Engineer. This work, materials, and equipment, when required, will be ordered in writing by the Engineer, at a lump sum price or at a non-lump sum price. Price negotiations will consider reasonable marker values (at the time of construction) for proposed items).

**Lump Sum**

When a lump sum price is used, the lump sum price will be determined by negotiation, and only require written pre-approval by the Engineer as backup documentation for payment purposes.

**Non-Lump Sum**

When non-lump sum price is used, compensation shall be limited to the Contractor's reasonable costs plus markup percentages stipulated in this contract. The basis of the non-lump sum negotiated prices and subcontractor invoices will be included in pay application; copies of invoices, equipment cost estimations and other supporting documentation will be included.

**Payment Item**

Item no. 999-0000 Unspecified Work – per each

## END OF SECTION 999-0000

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# TECHNICAL SPECIFICATIONS

# DIVISION 02
# EXISTING CONDITIONS

# SECTION 02 41 19 - SELECTIVE BUILDING DEMOLITION

## PART 1 – GENERAL

1.01 WORK INCLUDED

A. Work includes all labor, materials, equipment, and supervision necessary to complete all removal of building demolition work and site improvement including salvage, removal and disposal services required as indicated on Plans.

B. BEFORE STARTING WORK, ARRANGE TO SHUT DOWN UTILITIES AND SERVICE LINES IN AREA OF DEMOLITION WORK. BE SURE THAT LOCATIONS OF UTILITIES IN VICINITY ARE KNOWN AND IDENTIFIED AS "IN SERVICE" OR "SHUT DOWN". COORDINATE DEMOLITION AND UTILITY SHUT DOWN OF PLUMBING SYSTEMS WITH OTHER TRADES ON SITE.

C. WHERE CONDUIT ASSOCIATED WITH AN ITEM TO BE REMOVED IS LOCATED IN AN INACCESSIBLE AREA, SUCH AS ENCASED IN CONCRETE, THE INACCESSIBLE CONDUIT ONLY, SHALL BE ABANDONED IN PLACE, UNLESS OTHERWISE INDICATED TO BE RE-USED. ALL CONDUCTORS SHALL BE REMOVED AND CONDUIT SHALL BE CUT OFF FLUSH AND SEALED OR CAPPED.

1.02 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

C. Remove and Salvage: Detach items from existing construction and deliver them to Airport Operations for reuse.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 QUALITY ASSURANCE

A. Qualifications of Demolition Contractor:

1. Demolition shall be performed only by a qualified Contractor with at least five (5) years documented experience in operations of a similar nature.

B. Requirements of Regulatory Agencies:

1. Comply with governing local and state safety codes pertaining to demolition work, and the following:

a. ANSI A10.6 Safety Requirements for Demolition Operations.
b. NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations.

2. Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.04 SUBMITTALS

A. Schedule:

1. Submit schedule for any temporary disconnection of electrical, telephone, security, mechanical and/or plumbing service for Airport Operations approval. Such disconnections shall be restricted to outside of normal operating and/or business hours.

1.05 JOB CONDITIONS

A. Condition of Areas:

1. The Airport Operations assumes no responsibility for actual condition of areas to be demolished.

B. Protection of Existing Construction:

1. Existing construction adjacent to demolition operations, and those portions designated to remain shall be given maximum protection while demolition work is in process. Damage to these portions shall be repaired or replaced at no additional cost to Airport Operations.

C. Salvage:

1. If indicated or otherwise required by Airport Operations, salvageable items shall include both existing items which shall be removed and relocated to new areas or re-used in existing locations as indicated on Plans; and salvageable items which shall be turned over to Airport Operations for future maintenance. In both cases, salvageable items shall remain the property of Airport Operations and be carefully removed from the structure as work progresses. Items to be salvaged or re-used shall be determined by Engineer and/or Airport Operations.

2. Items to be re-used shall be stored in a safe, secure area, and be protected from damage until they are re-installed per Plans. Items which are to be turned over to Airport Operations for future maintenance shall be transported to an area designated by Airport Operations.

3. All salvageable items indicated on Plans to be removed, which are not specifically scheduled for re-use, relocation, or future maintenance, shall become the property of the Contractor and shall be removed from the job site and premises.

D. Protection:

1. Ensure safe passage of persons around area of demolition. Conduct operations to prevent injury to adjacent structures, other facilities, and persons.

2. Erect temporary barriers and passageways as required.

E. Utility Services:

1. Existing utilities indicated to remain and to be kept in service, shall be maintained and protected against damage during demolition operations.

2. DO NOT interrupt existing utilities serving occupied or "in-use" facilities, except when authorized in writing by Airport Operations.

3. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

## PART 2 - PRODUCTS

"Not Used"

## PART 3 - EXECUTION

3.01 PREPARATION

A. Posting of Danger Signs:

1. Danger signs shall be conspicuously posted around demolition areas.

B. Access to Demolition Area:

1. With the exception of passageways and ladders for the use of workmen, access to demolition areas shall be entirely closed off at all times.

C. Temporary Shoring:

1. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

2. Strengthen or add new supports when required during progress of demolition.

3.02 PROTECTION

A. Protect existing work that is to remain in place, that is to be re-used, or that is to remain the property of the Airprot, by temporary covers, shoring, bracing, and supports. Repair items damaged during performance of the work or replace with new. DO NOT overload structural elements. Provide new supports or reinforcement for existing construction weakened by demolition or removal work.

3.03 DEMOLITION

A. Remove structural framing members (if applicable) and lower to ground by method suitable to minimize ground impact or dust generation.

B. Concrete: Cut concrete full depth at junctures with construction indicated to remain, using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Cut masonry at junctures with construction indicated to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished at junctures with construction indicated to remain, then break up and remove.

E. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction as indicated on Plans.

F. NO materials shall be dropped (by gravity) to any point.

3.04 FILLING VOIDS

A. If required, foundations and all other items removed shall have resulting void completely filled as follows:

1. Use satisfactory soil materials as defined in ASTM D 2487, consisting of stone, gravel, and sand, free from debris and trash.

2. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, trash and debris.

3. Place fill materials in horizontal layers not exceeding 6-inches in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, but not less than 90 percent density when tested in accordance with ASTM D 1556, unless subsequent excavation for new work is required.

4. After fill placement and compaction, grade surface to meet adjacent contours.

3.05 DUST CONTROL

A. Use temporary enclosures, and other suitable methods to limit dust and dirt rising and scattered in air to lowest practical level.

B. Take appropriate action to check the spread of dust and to avoid the creation of a nuisance in the surrounding area. DO NOT use water.

C. Comply with governing regulations pertaining to environmental protection.

3.05 DISPOSAL

A. Except for all items to be salvaged, all parts of the structures and appurtenances and all materials recovered during their demolition shall become the property of the Contractor; shall be removed from the Project by the Contractor; and disposed of off-site in a legal manner.

3.06 CLEAN-UP

A. Clean adjacent construction and improvements of dust, dirt, and debris caused by demolition operations, to a degree acceptable to the Engineer and Airport Operations. Return adjacent areas to condition existing prior to start of demolition work.

B. Keep building areas including exterior, clean and free of debris at all times.

## END OF SECTION 02 41 19

# TECHNICAL SPECIFICATIONS

# DIVISION 03
# CONCRETE

# SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 117 | (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary |
| ACI 211.1 | (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete |
| ACI 301 | (2016) Specifications for Structural Concrete |
| ACI 302.1R | (2015) Guide for Concrete Floor and Slab Construction |
| ACI 304.2R | (1996; R 2008) Placing Concrete by Pumping Methods |
| ACI 304R | (2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete |
| ACI 305R | (2010) Guide to Hot Weather Concreting |
| ACI 306.1 | (1990; R 2002) Standard Specification for Cold Weather Concreting |
| ACI 306R | (2016) Guide to Cold Weather Concreting |
| ACI 308.1 | (2011) Specification for Curing Concrete |
| ACI 318 | (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016) Building Code Requirements for Structural Concrete and Commentary |
| ACI 347 | (2004; Errata 2008; Errata 2012) Guide to Formwork for Concrete |
| ACI SP-2 | (2007; Abstract: 10th Edition) ACI Manual of Concrete Inspection |
| ACI SP-66 | (2004) ACI Detailing Manual |

AMERICAN HARDBOARD ASSOCIATION (AHA)

| | |
|---|---|
| AHA A135.4 | (1995; R 2004) Basic Hardboard |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.4/D1.4M | (2011) Structural Welding Code - Reinforcing Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A1064/A1064M | (2016b) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM A615/A615M | (2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A706/A706M | (2016) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement |
| ASTM A934/A934M | (2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars |
| ASTM A996/A996M | (2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| ASTM C1017/C1017M | (2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete |
| ASTM C1077 | (2016) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| ASTM C1107/C1107M | (2014a) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
| ASTM C1260 | (2014) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) |
| ASTM C143/C143M | (2015a) Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C150/C150M | (2016; E 2016) Standard Specification for Portland Cement |
| ASTM C1567 | (2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method) |
| ASTM C1602/C1602M | (2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete |
| ASTM C172/C172M | (2014a) Standard Practice for Sampling Freshly Mixed Concrete |
| ASTM C173/C173M | (2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method |
| ASTM C192/C192M | (2016a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory |
| ASTM C231/C231M | (2014) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C295/C295M | (2012) Petrographic Examination of Aggregates for Concrete |

| | |
|---|---|
| ASTM C31/C31M | (2015a; E 2016) Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C311/C311M | (2013) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete |
| ASTM C33/C33M | (2016) Standard Specification for Concrete Aggregates |
| ASTM C39/C39M | (2016b) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C42/C42M | (2013) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C494/C494M | (2016) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C618 | (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete |
| ASTM C78/C78M | (2016) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading) |
| ASTM C94/C94M | (2016a) Standard Specification for Ready-Mixed Concrete |
| ASTM C989/C989M | (2014) Standard Specification for Slag Cement for Use in Concrete and Mortars |
| ASTM D412 | (2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension |
| ASTM D471 | (2016a) Standard Test Method for Rubber Property - Effect of Liquids |
| ASTM D5759 | (2012) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses |
| ASTM E1155 | (2014) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers |
| ASTM E1643 | (2011) Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs |
| ASTM E1745 | (2011) Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs |
| ASTM E1993/E1993M | (1998; R 2013; E 2013) Standard Specification for Bituminous Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs |
| ASTM E329 | (2014a) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction |
| ASTM E96/E96M | (2016) Standard Test Methods for Water Vapor Transmission of Materials |

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

| | |
|---|---|
| CRSI 10MSP | (2009; 28th Ed) Manual of Standard Practice |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST PS 1 | (2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| COE CRD-C 513 | (1974) Corps of Engineers Specifications for Rubber Waterstops |
| COE CRD-C 572 | (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops |

## 1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and ground granulated blast-furnace slag.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.

e. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

f. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

g. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Personnel Certifications; G

Laboratory Accreditation; G

SD-02 Shop Drawings

Formwork

Reinforcing Steel; G

SD-03 Product Data

Materials for Forms

Cementitious Materials

Vapor Barrier

Joint Sealants

Concrete Curing Materials

Reinforcement

Admixtures

Waterstops

SD-05 Design Data

Concrete Mix Design; G

SD-06 Test Reports

Fly Ash

Pozzolan

Ground Granulated Blast-Furnace Slag

Aggregates

Tolerance Report

Compressive Strength Tests; G

Air Content

Slump Tests

Water

SD-07 Certificates

Reinforcing Bars

Welder Qualifications

VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Curing Compound

## 1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Follow ACI 301, ACI 304R and ASTM A934/A934M requirements and recommendations. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

### 1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

## 1.6 QUALITY ASSURANCE

### 1.6.2 Shop Drawings

#### 1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

#### 1.6.2.2 Reinforcing Steel

ACI SP-66. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Reproductions of contract drawings are unacceptable.

### 1.6.3 Control Submittals

#### 1.6.3.5 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

### 1.6.4 Test Reports

#### 1.6.4.1 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date.

#### 1.6.4.2 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C989/C989M for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date.

#### 1.6.4.3 Aggregates

ASTM C1260 for potential alkali-silica reactions, ASTM C295/C295M for petrographic analysis.

### 1.6.7 Quality Control Personnel Certifications

#### 1.6.7.2 Field Testing Technician and Testing Agency

Submit data on qualifications of proposed testing agency and technicians for approval by the Contracting Officer prior to performing testing on concrete.

a. Work on concrete under this contract must be performed by an ACI Concrete Field Testing Technician Grade 1 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs must include requirements for written and performance examinations as stipulated in ACI SP-2.

b. Testing agencies that perform testing services on reinforcing steel must meet the requirements of ASTM E329.

c. Testing agencies that perform testing services on concrete materials must meet the requirements of ASTM C1077.

### 1.6.8 Laboratory Qualifications for Concrete Qualification Testing

The concrete testing laboratory must have the necessary equipment and experience to accomplish required testing. The laboratory must meet the requirements of ASTM C1077 and be Cement and Concrete Reference Laboratory (CCRL) inspected.

### 1.6.9 Laboratory Accreditation

Laboratory and testing facilities must be provided by and at the expense of the Contractor. The laboratories performing the tests must be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation must be current and must include the required test methods, as specified. Furthermore, the testing must comply with the following requirements:

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies must be performed by an accredited laboratory and under the direction of a certified ACI technician who is competent in concrete materials and must sign all reports and designs.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M.

c. Contractor Quality Control: All sampling and testing must be performed by an approved, onsite, independent, accredited laboratory.

## 1.9 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

# PART 2 PRODUCTS

## 2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

### 2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Virgin wood used must be FSC-certified.

#### 2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

#### 2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

### 2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

## 2.2 FORM TIES AND ACCESSORIES

Provide a form tie system that does not leave mild steel after break-off or removal any closer than 2 inches from the exposed surface. Do not use wire alone. Form ties and accessories must not reduce the effective cover of the reinforcement.

### 2.2.1 Waterstops

#### 2.2.1.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

#### 2.2.1.2 Rubber Waterstop

Rubber waterstops must conform to COE CRD-C 513.

#### 2.2.1.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to ASTM D471.

#### 2.2.1.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

### 2.2.2 Dovetail Anchor Slot

Preformed metal slot approximately 1 inch by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

## 2.3 CONCRETE MIX DESIGN

### 2.3.2 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) as specified below. Where faster set time is required, use Type III cement before using calcium chloride with approval from the contracting officer.

#### 2.3.2.1 Footings

Proportion normal-weight concrete mixture as follows:

a. Minimum Compressive Strength: 4000 psi at 28 days.

b. Maximum Water-Cementitious Materials Ratio: 0.45.

c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

d. Air Content: 0 percent for 3/4-inch nominal maximum aggregate size.

#### 2.3.2.3 Slab-on-Grade

Proportion normal-weight concrete mixture as follows:

a. Minimum Compressive Strength: 4000 psi at 28 days.

b. Maximum Water-Cementitious Materials Ratio: 0.45.

c. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

d. Air Content: 0 percent, for 3/4 inch nominal maximum aggregate size.

e. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

#### 2.3.2.8 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions and consistencies suitable for the work on methodology described in ACI 211.1. In the trial mixture, use at least three different water-cementitious material ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cementitious material ratio allowed must be based on equivalent water-cementitious material ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cementitious material ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M for 7, 28, days. From these results, plot a curve showing the relationship between water-cementitious material ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

#### 2.3.2.10 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301, but may not exceed the specified strength at the same age by more than 20 percent. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI 301.

### 2.3.3 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

Type and brand cement

Cement and complementary cementitious materials content in 94-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water cementitious material ratio

### 2.3.4 Concrete Curing Materials

Provide concrete curing material in accordance with ACI 301 Section 5 and ACI 308.1 Section 2. Submit product data for concrete curing compounds. Submit manufactures instructions for placement of curing compound.

## 2.4 MATERIALS

### 2.4.1 Cementitious Materials

For exposed concrete, use one manufacturer and one source for each type of cement, ground slag, fly ash, and pozzolan.

#### 2.4.1.1 Fly Ash

ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 6 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 8 percent and a total equivalent alkali content less than 1.5 percent.

Add with cement. Fly ash content must be a minimum of 20 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

#### 2.4.1.2 Raw or Calcined Natural Pozzolan

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

#### 2.4.1.3 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.

b. The average particle size must not exceed 6 microns.

c. The sum of SiO2 + Al2O3 + Fe2O3 must be greater than 77 percent.

#### 2.4.1.4 Ground Granulated Blast-Furnace Slag

ASTM C989/C989M, Grade 120. Slag content must be a minimum of 50 percent by weight of cementitious material.

#### 2.4.1.6 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type I with tri-calcium aluminates (C3A) content less than 10 percent and a maximum cement-alkali content of 0.80 percent Na2Oe (sodium oxide) equivalent. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

### 2.4.2 Water

Water must comply with the requirements of ASTM C1602/C1602M. Minimize the amount of water in the mix. Improve workability by adjusting the grading rather than by adding water. Water must be potable;

free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete. Submit test report showing water complies with ASTM C1602/C1602M.

### 2.4.3 Aggregates

ASTM C33/C33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement. Submit test report showing compliance with ASTM C33/C33M.

Fine and coarse aggregates must show expansions less than 0.08 percent at 28 days after casting when testing in accordance with ASTM C1260. Should the test data indicate an expansion of 0.08 percent or greater, reject the aggregate(s) or perform additional testing using ASTM C1567 using the Contractor's proposed mix design. In this case, include the mix design low alkali portland cement and one of the following supplementary cementitious materials:

1. GGBF slag at a minimum of 40 percent of total cementitious

2. Fly ash or natural pozzolan at a minimum of total cementitious of

    a. 30 percent if ($SiO_2$ plus $Al_2O_3$ plus $Fe_2O_3$) is 65 percent or more,
    b. 25 percent if ($SiO_2$ plus $Al_2O_3$ plus $Fe_2O_3$) is 70 percent or more,
    c. 20 percent if ($SiO_2$ plus $Al_2O_3$ plus $Fe_2O_3$) is 80 percent or more,
    d. 15 percent if ($SiO_2$ plus $Al_2O_3$ plus $Fe_2O_3$) is 90 percent or more.

If a combination of these materials is chosen, the minimum amount must be a linear combination of the minimum amounts above. Include these materials in sufficient proportion to show less than 0.08 percent expansion at 28 days after casting when tested in accordance with ASTM C1567.

Aggregates must not possess properties or constituents that are known to have specific unfavorable effects in concrete when tested in accordance with ASTM C295/C295M.

#### 2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

ASTM C33/C33M, uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

### 2.4.4 Nonshrink Grout

ASTM C1107/C1107M.

### 2.4.5 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Submit product data for admixtures used in concrete.

#### 2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C494/C494M, Type F and ASTM C1017/C1017M.

#### 2.4.6 Vapor Barrier

STM E1745 Class C polyethylene sheeting, minimum 15 mil thickness or ASTM E1993/E1993M bituminous membrane or other equivalent material with a maximum permeance rating of 0.01 perms per ASTM E96/E96M.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

#### 2.4.8 Joint Sealants

Submit manufacturer's product data, indicating VOC content.

### 2.5 REINFORCEMENT

#### 2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. Use deformed steel. ASTM A615/A615M with the bars marked A, Grade 60; or ASTM A996/A996M with the bars marked R, Grade 60, or marked A, Grade 60. Submit mill certificates for reinforcing bars.

##### 2.5.1.2 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to ASTM A706/A706M and ASTM A615/A615M and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

#### 2.5.3 Wire

##### 2.5.3.1 Welded Wire Reinforcement

ASTM A1064/A1064M. Provide flat sheets of welded wire reinforcement for slabs and toppings.

##### 2.5.3.2 Steel Wire

Wire must conform to ASTM A1064/A1064M.

#### 2.5.4 Reinforcing Bar Supports

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place.

Provide wire bar type supports of coated or non-corrodible material conforming to ACI SP-66 and CRSI 10MSP.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are level.

If substrate preparation is the responsibility of another installer, notify Contracting Officer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Contracting Officer and wait for instructions before beginning installation.

## 3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

### 3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

### 3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

### 3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials.

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

### 3.2.4 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

### 3.2.5 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

## 3.3 FORMS

Provide forms, shoring, and scaffolding for concrete placement in accordance with ACI 301 Section 2 and 5 and ACI 347. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris.

### 3.3.1 Coating

Before concrete placement, coat the contact surfaces of forms with a form release agent.

### 3.3.3 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised. Wood forms must not be clogged with paste and must be capable of absorbing high water-cementitious material ratio paste.

### 3.3.4 Forms for Standard Rough Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-1.0, for formed surfaces that are to be concealed by other construction.

### 3.3.5 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view. Do not provide mockup of concrete surface appearance and texture.

### 3.3.6 Form Ties

Provide ties in accordance with ACI 301 section 2.

### 3.3.7 Forms for Concrete Pan Joist Construction

Pan-form units for one-way or two-way concrete joist and slab construction must be factory-fabricated units of the approximate section indicated. Units must consist of steel or molded fiberglass concrete form pans. Closure units must be furnished as required.

### 3.3.9 Removal of Forms and Supports

After placing concrete, removal of forms must be in accordance with ACI 301 Section 2 except as modified by approved form removal schedule.

## 3.4 WATERSTOP INSTALLATION AND SPLICES

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

### 3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

### 3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

### 3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and

contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

#### 3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

## 3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301 and ACI SP-66. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

#### 3.5.1 General

Provide details of reinforcement that are in accordance with ACI 301 and ACI SP-66 and as specified.

#### 3.5.2 Vapor Barrier

Install in accordance with ASTM E1643. Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape. Remove torn, punctured, or damaged vapor barrier material and provide with vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material.

#### 3.5.4 Reinforcement Supports

Support reinforcement in accordance with ACI 301 Section 3. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

#### 3.5.6 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

#### 3.5.8 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement and support against displacement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

#### 3.5.9 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI 318 and ACI SP-66.

Provide hooks and bends that are in accordance with ACI 318 and ACI SP-66.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI SP-66.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b. Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

### 3.5.10 Placing Reinforcement

Place reinforcement in accordance with ACI 301 and ACI SP-66.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 318, ACI SP-66 and CRSI 10MSP. Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire reinforcement as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than 16 gage.

Reinforcement must be accurately placed, securely tied at intersections, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to ACI SP-66.

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in ACI SP-66 and ACI 318.

### 3.5.11 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the ACI 318 and ACI SP-66.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Contracting Officer.

### 3.5.12 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI 318 and ACI SP-66.

### 3.5.13 Welding

Welding must be in accordance with AWS D1.4/D1.4M.

## 3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, ACI 301, ACI 302.1R and ACI 304R, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

### 3.6.1 Measuring

Make measurements at intervals as specified in paragraphs SAMPLING and TESTING.

### 3.6.2 Mixing

ASTM C94/C94M, ACI 301 and ACI 304R. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cementitious material ratio are not exceeded and the required concrete strength is still met. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

### 3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

## 3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5.

### 3.7.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

### 3.7.2 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

### 3.7.3 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

### 3.7.4 Hot Weather

Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

### 3.7.5 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

## 3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

#### 3.8.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

#### 3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

#### 3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material.

### 3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

#### 3.9.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

#### 3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

#### 3.9.3 Formed Surfaces

##### 3.9.3.1 Tolerances

ACI 117 and as indicated.

##### 3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

##### 3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

### 3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 301 and ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile or ceramic tile are indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

#### 3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

#### 3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

#### 3.10.1.4 Steel Troweled

Use for floors intended as walking surfaces and for reception of floor coverings. Finish concrete in accordance with ACI 301 Section 5 for a steel troweled finish.

#### 3.10.1.6 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

### 3.10.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 7.15.3, "Typical Composite Ff/FL Values for Various Construction Methods." ACI 117 for tolerance tested by ASTM E1155.

a. Specified Conventional Value:

Floor Flatness (Ff) 20 minimum
Floor Levelness (FL) 15

b. Specified Industrial:

Floor Flatness (Ff) 30
Floor Levelness (FL) 20

#### 3.10.2.1 Measurement of Floor Tolerances

Test slab within 24 hours of the final troweling. Provide tests to Contracting Officer within 12 hours after collecting the data. Floor flatness inspector is required to provide a tolerance report which must include:

a. Key plan showing location of data collected.

b. Results required by ASTM E1155.

#### 3.10.2.2 Remedies for Out of Tolerance Work

Contractor is required to repair and retest any floors not meeting specified tolerances. Prior to repair, Contractor must submit and receive approval for the proposed repair, including product data from any materials proposed. Repairs must not result in damage to structural integrity of the floor. For floors exposed to public view, repairs must prevent any uneven or unusual coloring of the surface.

## 3.11 JOINTS

### 3.11.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Joints must be perpendicular to main reinforcement. Reinforcement must be continued and developed across construction joints. Locate construction joints as follows:

#### 3.11.1.1 Maximum Allowable Construction Joint Spacing

a. In walls at not more than 60 feet in any horizontal direction.

b. In slabs on ground, as shown on drawings.

#### 3.11.1.2 Construction Joints for Constructability Purposes

a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

### 3.11.2 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

## 3.13 CURING AND PROTECTION

ACI 301 Section 5, unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

### 3.13.1 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

### 3.13.2 Curing Periods

ACI 301 Section 5, except 10 days for retaining walls, pavement or chimneys. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

### 3.13.3 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

### 3.13.4 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

### 3.13.5 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

### 3.13.6 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

### 3.13.7 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

## 3.14 FIELD QUALITY CONTROL

### 3.14.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

### 3.14.2 Testing

#### 3.14.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement/discharge. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cementitious material ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

#### 3.14.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

#### 3.14.2.3 Compressive Strength Tests

ASTM C39/C39M. Make six 6 inch by 12 inch test cylinders for each set of tests in accordance with ASTM C31/C31M, ASTM C172/C172M and applicable requirements of ACI 305R and ACI 306R. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold two cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of ACI 318 Section 5.6. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

#### 3.14.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

#### 3.14.2.7 Strength of Concrete Structure

The strength of the concrete structure will be considered to be deficient if any of the following conditions are identified:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

Where the strength of the concrete structure is considered deficient submit a mitigation or remediation plan for review and approval by the contracting officer.

#### 3.14.2.8 Non-Conforming Materials

Factors that indicate that there are non-conforming materials include (but not limited to) excessive compressive strength, inadequate compressive strength, excessive slump, excessive voids and honeycombing, concrete delivery records that indicate excessive time between mixing and placement, or excessive water was added to the mixture during delivery and placement. Any of these indicators alone are sufficient reason for the Contracting Officer to request additional sampling and testing.

Investigations into non-conforming materials must be conducted at the Contractor's expense. The Contractor must be responsible for the investigation and must make written recommendations to adequately mitigate or remediate the non-conforming material. The Contracting Officer may accept, accept with reduced payment, require mitigation, or require removal and replacement of non-conforming material at no additional cost to the Government.

#### 3.14.2.9 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements or there are non-conforming materials, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

## 3.15 REPAIR, REHABILITATION AND REMOVAL

Before the Contracting Officer accepts the structure the Contractor must inspect the structure for cracks, damage and substandard concrete placements that may adversely affect the service life of the structure. A report documenting these defects must be prepared which includes recommendations for repair, removal or remediation must be submitted to the Contracting Officer for approval before any corrective work is accomplished.

### 3.15.1 Crack Repair

Prior to final acceptance, all cracks in excess of 0.02 inches wide must be documented and repaired. The proposed method and materials to repair the cracks must be submitted to the Contracting Officer for approval. The proposal must address the amount of movement expected in the crack due to temperature changes and loading.

### 3.15.2 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Concrete surfaces with weak surfaces less than 1/4 inch thick must be diamond ground to remove the weak surface. Surfaces containing weak surfaces greater than 1/4 inch thick must be removed and replaced or mitigated in a manner acceptable to the Contracting Officer.

### 3.15.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

## END OF ITEM 03 30 00

# TECHNICAL SPECIFICATIONS

# DIVISION 04
# MASONRY

# SECTION 04 20 00 - UNIT MASONRY

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

| | |
|---|---|
| ACI 318 | (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016) Building Code Requirements for Structural Concrete and Commentary |
| ACI SP-66 | (2004) ACI Detailing Manual |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A1008/A1008M | (2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| ASTM A1064/A1064M | (2016b) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM A153/A153M | (2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A167 | (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A185/A185M | (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete |
| ASTM A615/A615M | (2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A641/A641M | (2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM A653/A653M | (2015; E 2016) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A951/A951M | (2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement |
| ASTM A996/A996M | (2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement |
| ASTM B370 | (2012) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM C1019 | (2014) Standard Test Method for Sampling and Testing Grout |

| | |
|---|---|
| ASTM C1384 | (2012a) Standard Specification for Admixtures for Masonry Mortars |
| ASTM C1611/C1611M | (2014) Standard Test Method for Slump Flow of Self-Consolidating Concrete |
| ASTM C1634 | (2011) Standard Specification for Concrete Facing Brick |
| ASTM C270 | (2014a) Standard Specification for Mortar for Unit Masonry |
| ASTM C476 | (2016) Standard Specification for Grout for Masonry |
| ASTM C494/C494M | (2016) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C641 | (2009) Staining Materials in Lightweight Concrete Aggregates |
| ASTM C67 | (2014) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile |
| ASTM C780 | (2015a) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry |
| ASTM C90 | (2016) Standard Specification for Loadbearing Concrete Masonry Units |
| ASTM D2000 | (2012) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D2287 | (2012) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds |

THE MASONRY SOCIETY (TMS)

| | |
|---|---|
| TMS MSJC | (2011) Masonry Standard Joint Committee's (MSJC) Book - Building Code Requirements and Specification for Masonry Structures, Containing TMS 402/ACI 530/ASCE 5, TMS 602/ACI 530.1/ASCE 6, and Companion Commentaries |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Cut CMU Drawings; G

Reinforcement Detail Drawings; G

SD-03 Product Data

Hot Weather Procedures; G

Cold Weather Procedures; G

Cement; G

Insulation; G

SD-04 Samples

Mock-Up Panel; G

Concrete Masonry Units (CMU); G

Joint Reinforcement; G

SD-05 Design Data

Masonry Compressive Strength; G

Bracing Calculations; G

SD-06 Test Reports

Field Testing of Mortar

Field Testing of Grout

SD-07 Certificates

Concrete Masonry Units (CMU)

Concrete Brick

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

## 1.3 QUALITY ASSURANCE

### 1.3.1 Masonry Mock-Up Panels

#### *1.3.1.1 Mock-Up Panel Location*

After material samples are approved and prior to starting masonry work, construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

#### *1.3.1.2 Mock-Up Panel Configuration*

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 8 feet long by 4 feet high.

#### *1.3.1.3 Mock-Up Panel Composition*

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a masonry bonded corner and installation of electrical boxes and conduit. When the panel represents reinforced masonry, include a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

#### *1.3.1.4 Mock-Up Panel Construction Method*

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

#### *1.3.1.5 Mock-Up Panel Purpose*

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

### 1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.

b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

### 1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

### 1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

## 1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

### 1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

### 1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

#### 2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, f'm, is as indicated for each type of masonry.

#### 2.1.2 Performance - Verify Masonry Compressive Strength

Verify specified compressive strength of masonry using the "Unit Strength Method" of TMS MSJC. Submit calculations and certifications of unit and mortar strength.

Verify specified compressive strength of masonry using the "Prism Test Method" of TMS MSJC when the "Unit Strength Method" cannot be used. Submit test results.

### 2.2 MANUFACTURED UNITS

#### 2.2.1 General Requirements

Do not change the source of materials, which will affect the appearance of the finished work, after the work has started except with Contracting Officer's approval. Submit test reports from an approved independent laboratory. Certify test reports on a previously tested material as the same materials as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

#### 2.2.3 Concrete Units

##### *2.2.3.1 Aggregates*

Test lightweight aggregates, and blends of lightweight and heavier aggregates in proportions used in producing the units, for stain-producing iron compounds in accordance with ASTM C641,visual classification method. Do not incorporate aggregates for which the iron stain deposited on the filter paper exceeds the "light stain" classification.

Use industrial waste by-products (air-cooled slag, cinders, or bottom ash), ground waste glass and concrete, granulated slag, and expanded slag in aggregates.

##### *2.2.3.2 Concrete Masonry Units (CMU)*

###### 2.2.3.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

###### 2.2.3.2.3 Size

Provide units with specified nominal dimension of 8 inches wide, 8 inches high, and 16 inches long.

###### 2.2.3.2.4 Surfaces

Provide units with exposed surfaces that are smooth and of uniform texture.

2.2.3.2.5 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather..

2.2.3.2.6 Unit Types

a. Hollow Load-Bearing Units: ASTM C90, normal weight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Solid Load-Bearing Units: ASTM C90, lightweight or normal weight units. Provide solid units as indicated.

*2.2.3.3 Architectural Units*

Provide architectural units with patterned face shell: vertical scored and split ribbed.

*2.2.3.7 Concrete Brick*

2.2.3.7.2 Concrete Brick for Facing

Provide concrete brick for exposed applications that conforms to ASTM C1634. Submit samples as specified.

2.2.4 Precast Concrete Units

*2.2.4.1 General*

a. Provide precast concrete trim, lintels, copings, splashblocks and sills that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 4,000 psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 3/4 inch between reinforcement and faces of units.

b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with a smooth dense finish.

d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

e. Provide architectural cast stone masonry trim, copings, heads, and sills that are manufactured in a plant by a producer regularly engaged in producing cast stone. Provide cast stone units that comply with ASTM C1364. Submit test reports and three exemplars of the same cast stone product installed in similar projects in similar climatic conditions.

*2.2.4.2 Precast Concrete Lintels*

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 36 inches in length. Provide at least 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of 4000 psi. Limit lintel deflection due to dead plus live load to L/600 or 0.3 inches.

*2.2.4.3 Precast Concrete Sills and Copings*

Cast sills and copings washes. For windows having mullions, cast sills in sections with head joints at mullions and a 1/4 inch allowance for mortar joints. Roughen the ends of sills, except a 3/4 inch wide margin at exposed surfaces, for bond. Provide rounded nosings on treads of door sills.

## 2.3 EQUIPMENT

### 2.3.1 Vibrators

Maintain at least one spare vibrator on site at all times.

### 2.3.2 Grout Pumps

Pumping through aluminum tubes is not permitted.

## 2.4 MATERIALS

### 2.4.1 Mortar Materials

*2.4.1.1 Cementitious Materials*

Provide cementitious materials that conform to those permitted by ASTM C270.

*2.4.1.4 Admixtures for Masonry Mortar*

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

*2.4.1.5 Aggregate and Water*

Provide aggregate (sand) and water that conform to materials permitted by ASTM C270.

### 2.4.2 Grout and Ready-Mix Grout Materials

*2.4.2.1 Cementitious Materials for Grout*

Provide cementitious materials that conform to those permitted by ASTM C476.

*2.4.2.2 Admixtures for Grout*

Water-reducing admixtures that conform to ASTM C494/C494M Type F or G and viscosity-modifying admixtures that conform to ASTM C494/C494M Type S are permitted for use in grout. Other admixtures require approval by the Contracting Officer.

In cold weather, a non-chloride based accelerating admixture may be used subject to approval by the Contracting Officer; use accelerating admixture that is non-corrosive and conforms to ASTM C494/C494M, Type C.

*2.4.2.3 Aggregate and Water*

Provide fine and coarse aggregates and water that conform to materials permitted by ASTM C476.

## 2.5 MORTAR AND GROUT MIXES

### 2.5.1 Mortar Mix

a. Provide mortar Type M unless specified otherwise herein.

b. Use ASTM C270 Type M cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated.

c. Provide mortar that conforms to ASTM C270. Use Type M mortar.

c. For field-batched mortar, measure component materials by volume. Use measuring boxes for materials that do not come in packages, such as sand, for consistent batching. Mix cementitious materials and aggregates between 3 and 5 minutes in a mechanical batch mixer with a sufficient amount of water to produce a workable consistency. Do not hand mix mortar unless approved by the Contracting Officer. Maintain workability of mortar by remixing or retempering. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

d. For preblended mortar, follow manufacturer's mixing instructions.

### 2.5.2 Grout and Ready Mix Grout Mix

Use grout that conforms to ASTM C476. Use conventional grout with a slump between 8 and 11 inches. Use self-consolidating grout with slump flow of 24 to 30 inches and a visual stability index (VSI) not greater than 1. Provide minimum grout strength of 3000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

## 2.6 ACCESSORIES

### 2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

### 2.6.2 Anchors, Ties, and Bar Positioners

*2.6.2.1 General*

a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.

b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.

c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.

d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.

*2.6.2.2 Wire Mesh Anchors*

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

*2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction*

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized W2.8 diameter steel wire. Provide rectangular wall ties no less than 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

*2.6.2.4 Dovetail Anchors*

Provide dovetail anchors of 3/16 inch diameter steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. Use these anchors to connect the exterior masonry wythe as it passes over the face of concrete columns, beams, or walls. Fill cells immediately above and below these anchors unless solid units are used. Furnish dovetail slots, which are specified to be installed by others, in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

*2.6.2.5 Adjustable Anchors*

2.6.2.5.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing

Use one of the following types of adjustable anchors to connect veneer to light gauge steel or concrete backing:

a. sheet metal at least 7/8 inch wide, 0.06 inch thick, and with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch or bent, notched or punched to provide equivalent performance;

b. wire anchors of minimum size W1.7 with ends bent to form a minimum 2 inches extension and without drips;

c. or wire pintle anchors used in conjunction with joint reinforcement.

Do not exceed 1/16 inch clearance between connecting parts of the tie. Assemble adjustable anchors to prevent disengagement. Provide pintle anchors with one or more pintle legs of wire size W2.8 and an offset not exceeding 1-1/4 inch.

*2.6.2.7 Bar Positioners*

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60.

2.6.5 Concrete Masonry Control Joint Keys

Provide control joint keys of a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D2000 M2AA-805 with a minimum durometer hardness of 80 or polyvinyl chloride conforming to ASTM D2287 Type PVC 654-4 with a minimum durometer hardness of 85. Form the control joint key with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch, to fit neatly, but without forcing, in masonry unit jamb sash grooves.

2.6.7 Through Wall Flashing and Weeps

*2.6.7.1 General*

Provide coated copper, copper or stainless steel sheet, self-adhesive rubberized sheet, or reinforced membrane sheet flashing except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by dampproofing material.

*2.6.7.2 Coated-Copper Flashing*

Provide 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, asphalt impregnated kraft paper or polyethylene sheets.

*2.6.7.3 Copper or Stainless Steel Flashing*

Provide copper sheet, complying with ASTM B370, minimum 16 ounce weight; or stainless steel, ASTM A167, Type 304 or 316, 0.015 inch thick, No. 2D finish. Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in

all directions, where deformations consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

*2.6.7.6 Weep Ventilators*

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

*2.6.7.7 Metal Drip Edge*

Provide stainless steel drip edge, 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.8 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

## PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit bracing calculations, sealed by a registered professional engineer. Do not remove bracing in less than 10 days.

3.3 ERECTION

3.3.1 General

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Lay masonry units in running bond pattern. Lay facing courses level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances is plus or minus 1/2 inch. Adjust each unit to its final position while mortar is still soft and has plastic consistency.

b. Remove and clean units that have been disturbed after the mortar has stiffened, and relay with fresh mortar. Keep air spaces, cavities, chases, expansion joints, and spaces to be grouted free from mortar and other debris. Select units to be used in exposed masonry surfaces from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work.

c. When necessary to temporarily discontinue the work, step (rack) back the masonry for joining when work resumes. Toothing may be used only when specifically approved by the Contracting Officer. Before resuming work, remove loose mortar and thoroughly clean the exposed joint. Cover the top of walls subjected to rain or snow with nonstaining waterproof covering or membrane when work is not in process. Extend the covering a minimum of 610 mm 2 feet down on each side of the wall and hold securely in place.

d. Ensure that units being laid and surfaces to receive units are free of water film and frost. Lay solid units in a nonfurrowed full bed of mortar. Bevel mortar for veneer wythes and slope down toward the cavity side. Shove units into place so that the vertical joints are tight. Completely fill vertical joints between solid units with mortar, except where indicated at control, expansion, and isolation joints. Place hollow units so that mortar extends to the depth of the face shell at heads and beds, unless otherwise indicated. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Provide means to prevent mortar from dropping into the space below or clean grout spaces prior to grouting.

e. In multi-wythe construction with collar joints no more than 3/4 inch wide, bring up the inner wythe not more than 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

*3.3.1.1 Jointing*

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.3.1.1.4 Joint Widths

a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.

b. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.

c. Provide 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.

d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

*3.3.1.2 Cutting and Fitting*

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

*3.3.1.3 Unfinished Work*

Rack back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved by the Contracting Officer. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

*3.3.1.5 Control Joints*

Provide control joints in concrete masonry as indicated. Construct by using special control-joint units in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating

courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. Do not interrupt the horizontal reinforcement and grout at the control joint.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.2 Clay or Shale Brick Masonry

*3.3.2.2 Wetting of Units*

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C67. Ensure that each unit is nearly saturated when wetted but surface dry when laid.

Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.3.3 Anchored Veneer Construction

a. Construct exterior masonry wythes to the thickness indicated on the drawings. Provide a minimum 2 inch air space behind the masonry veneer. Provide means to ensure that the cavity space and flashings are kept clean of mortar droppings and other loose debris. Maintain chases and raked-out joints free from mortar and debris.

b. Place masonry in running bond pattern. Place longitudinal reinforcement, consisting of at least one continuous hot-dip galvanized W 1.7 (9gauge) steel wire, in the veneer wythe when laid in stack bond.

c. For veneer with a masonry backup wythe, lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, install through-wall flashings with the exterior wythe, securing the top edge of the flashing with a termination bar and sealant, or protect flashings that are installed with the interior wythe from damage until they are fully enclosed in the wall.

d. Provide anchors (ties) to connect the veneer to its backing in sufficient quantity to comply with the following requirements: maximum wall area per anchor {tie) of 2, and maximum vertical spacing of 16, and maximum horizontal spacing of 16. Provide additional anchors around openings larger than 16 inch in either direction. Space anchors around perimeter of opening at a maximum of 24 inches on center. Place anchors within 12 inches of openings. Anchors with drips are not permitted.

e. With solid units, embed anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar cover to the outside face.

f. With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar or grout cover to outside face.

3.3.4 Composite Walls

Tie masonry wythes together with joint reinforcement or with unit wall ties. Embed wall ties at least 1-1/2 inch into mortar of solid units and at least 1/2 inch into the mortar of the outer face shell of hollow units.

Provide at least one tie every 2.67 square feet for wire size W1.7 and at least one tie every 4.50 square feet for wire size W2.8. Space ties at a maximum of 36 inches horizontally and 24 inches vertically. Do not cross expansion joints or control joints with ties. Fill collar joints between masonry facing and masonry backup solidly with grout.

3.3.5 Reinforced, Single Wythe Concrete Masonry Units Walls

*3.3.5.1 Concrete Masonry Unit Placement*

a. Fully bed units used to form piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout in mortar under both face shells and webs. Provide mortar beds under both face shells for other units. Mortar head joints for a distance in from the face of the unit not less than the thickness of the face shell.

b. Solidly grout foundation walls below grade.

c. Stiffen double walls at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of each wall within the double wall. Adequately reinforce walls and partitions for support of wall-hung plumbing fixtures when chair carriers are not specified.

d. Submit drawings showing elevations of walls exposed to view and indicating the location of all cut CMU products.

*3.3.5.2 Preparation for Reinforcement*

Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be grouted. Remove mortar protrusions extending 1/2 inch or more into cells before placing grout. Position reinforcing bars accurately as indicated before placing grout. Where vertical reinforcement occurs, fill cores solid with grout in accordance with paragraph PLACING GROUT in this Section.

3.3.7 ANCHORAGE

*3.3.7.1 Anchorage to Concrete*

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

*3.3.7.2 Anchorage to Structural Steel*

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

*3.3.7.3 Anchorage at Intersecting Walls*

Provide wire mesh anchors at maximum 16 inches spacing at intersections of interior non-bearing masonry walls.

3.3.8 Lintels

*3.3.8.1 Masonry Lintels*

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated. Extend lintel reinforcement beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Support reinforcing bars in place prior to grouting and locate 1/2 inch above the bottom inside surface of the lintel unit.

*3.3.8.2 Precast Concrete and Steel Lintels*

Provide precast concrete and steel lintels as shown on the Drawings. Set lintels in a full bed of mortar with faces plumb and true. Provide steel and precast lintels with a minimum bearing length of 8 inches unless otherwise indicated. In partially grouted masonry, provide fully grouted units under the full lintel bearing length, unless otherwise indicated.

3.3.9 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 4 feet as indicated.

3.4 INSTALLATION

3.4.1 Bar Reinforcement Installation

*3.4.1.1 Preparation*

Submit detail drawings showing bar splice locations. Identify bent bars on a bending diagram and reference and locate such bars on the drawings. Show wall dimensions, bar clearances, and wall openings. Utilize bending details that conform to the requirements of ACI SP-66. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, resubmit the approved shop drawings with the additional openings shown along with the proposed changes. Clearly highlight location of these additional openings. Provide wall elevation drawings with minimum scale of 1/4 inch per foot. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, and other coatings that might destroy or reduce its bond prior to placing grout. Do not use bars with kinks or bends not shown on the approved shop drawings. Place reinforcement prior to grouting. Unless otherwise indicated, extend vertical wall reinforcement to within 2 inches of tops of walls.

*3.4.1.2 Positioning Bars*

a. Accurately place vertical bars within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted

tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.

b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.

c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.

d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

*3.4.1.3 Splices of Bar Reinforcement*

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

*3.4.2.1 General*

Fill cells containing reinforcing bars with grout. Solidly grout hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

*3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls*

In multi-wythe composite walls, provide grout barriers in the collar join not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

*3.4.2.3 Horizontal Grout Barriers*

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

*3.4.2.4 Grout Holes and Cleanouts*

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Fom such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units. provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

*3.4.2.5 Grout Placement*

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.

b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.

c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.

d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without

causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.

f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by edge of the termination bar securing the sheet metal flashing into a reglet cast into the concrete backup. Terminate the horizontal leg of the flashing by extending the sheet metal 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip. Provide sealant below the drip edge of through-wall flashing.

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course

below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. Tape or seal the joints between the boards.

3.5.2 Interface with Other Products

*3.5.2.1 Built-In Items*

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout, unless otherwise indicated.

*3.5.2.2 Door and Window Frame Joints*

On the exposed interior and exterior sides of exterior frames, rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

*3.5.2.3 Bearing Plates*

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Provide bedding mortar and non-shrink grout s specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

*3.6.1.1 Field Testing of Mortar*

Perform mortar testing at the following frequency: 2 times per day. For each required mortar test, provide a minimum of three mortar samples. Perform initial mortar testing prior to construction for comparison purposes during construction.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4.

*3.6.1.2 Field Testing of Grout*

a. Perform grout testing at the following frequency: 2 times per day. For each required grout property to be evaluated, provide a minimum of three specimens.

b. Sample and test conventional and self-conslidating grout for compressive strength and temperature in accordance with ASTM C1019.

c. Evaluate slump in conventional grout in accordance with ASTM C1019.

d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

## 3.7 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs and splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, rake out defects in joints of masonry to be exposed or painted, fill with mortar, and tool to match existing joints. Immediately after grout work is completed, remove scum and stains that have percolated through the masonry work using a low pressure stream of water and a stiff bristled brush. Do not clean masonry surfaces, other than removing excess surface mortar, until mortar in joints has hardened. Leave masonry surfaces clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Do not use metal tools and metal brushes for cleaning.

### 3.7.1 Dry-Brushing Concrete Masonry

Dry brush exposed concrete masonry surfaces at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

## 3.8 CLOSE-OUT TAKE-BACK PROGRAM

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial to be returned to manufacturer for recycling into new product. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

## 3.9 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane to protect from moisture intrusion when work is not in progress. Continue covering the top of the unfinished walls until the wall is waterproofed with a complete roof or parapet system. Extend covering a minimum of 2 feet down on each side of the wall and hold securely in place. Before starting or resuming work, clean top surface of masonry in place of loose mortar and foreign material.

**END OF SECTION 04 20 00**

# TECHNICAL SPECIFICATIONS

# DIVISION 05
# METALS

# SECTION 05 21 00 - STEEL JOIST FRAMING

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2014) Standard Specification for Carbon Structural Steel |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2015) International Building Code |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC PA 1 | (2000; E 2004) Shop, Field, and Maintenance Painting of Steel |
| SSPC Paint 15 | (1999; E 2004) Steel Joist Shop Primer |
| SSPC SP 2 | (1982; E 2000; E 2004) Hand Tool Cleaning |

STEEL JOIST INSTITUTE (SJI)

| | |
|---|---|
| SJI LOAD TABLES | (2010; Errata 1 2011; Errata 2 2012) 42nd Edition Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders |
| SJI MANUAL | (2009) 80 Years of Open Web Steel Joist Construction |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1926 | Safety and Health Regulations for Construction |
| 29 CFR 1926.757 | Steel Erection; Open Web Steel Joists |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welder Qualification

SD-02 Shop Drawings

Steel Joist Framing; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Erection Inspection

Welding Inspections

SD-07 Certificates

Certification of Compliance

## 1.3 QUALITY ASSURANCE

Perform all work in compliance with the requirements set forth in 29 CFR 1926.

### 1.3.1 Drawing Requirements

Submit drawings of steel joist framing including fabrication, specifications for shop painting, and identification markings of joists. Show joist type and size, layout in plan, all applicable loads, deflection criteria, and erection details including methods of anchoring, framing at openings, type, size, and location and connections for and spacing of bridging, requirements for field welding, and details of accessories as applicable.

### 1.3.2 Certification of Compliance

Prior to construction commencement, submit certification for welder qualification, in compliance with AWS D1.1/D1.1M, welding operation, and tacker, stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. Submit certification of compliance for the following:

a. SJI MANUAL

b. Steel Joist Institute Member Fabricator

c. 29 CFR 1926

d. 29 CFR 1926.757

e. Statement from steel joist manufacturer, that work was performed in accordance with approved construction documents and with SJI standard specifications, in accordance with ICC IBC Section 1704.2.5.2.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store joists in a manner to prevent damage affecting their structural integrity. Verify piece count of all joist products upon delivery and inspect all joists products for damage. Report any damage to the joist supplier. Store all items off the ground in a well drained location protected from the weather and easily accessible for inspection and handling. Store joists with top chord down and with joists in a vertical position. Store deep joists horizontally if they were shipped on their sides.

## PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Designate steel joists on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

2.2 STEEL JOISTS

Provide steel joists conforming to SJI LOAD TABLES. Design joists designated K, KCS, LH and DLH to support the loads given in the applicable standard load tables of SJI LOAD TABLES. Submit design calculations for net uplift loads, non-SJI standard details, and field splices. Include cover letter signed and sealed by the joist manufacturer's registered design professional.

2.2.1 Steel Joist Camber

Camber joists according to SJI LOAD TABLES.

2.2.2 Special Steel Joists

Provide special joists and connections capable of withstanding the design loads indicated with a live-load deflection less than L/240 for roof joists and L/360 for floor joists.

2.4 ACCESSORIES AND FITTINGS

2.4.1 Bridging

Provide bridging of material, size, and type required by SJI LOAD TABLES for type of joist, chord size, spacing and span. Furnish additional erection bridging if required for stability.

2.4.2 Bearing Plates

Fabricate steel bearing plats from ASTM A36/A36M steel of size and thickness indicated.

2.4.3 Ceiling Extensions

Furnish ceiling extensions, either bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

2.5 SHOP PAINTING

SSPC Paint 15. Shop prime joists, except as modified herein, in accordance with SSPC PA 1. Clean joists in accordance with SSPC SP 2 before priming. Do not prime joists to receive sprayed-on fireproofing. If flash rusting occurs, re-clean the surface prior to application of primer. For joists which require finish painting under Section 09 90 00 PAINTS AND COATINGS, the primer paint must be compatible with the finish paint.

## PART 3 EXECUTION

3.1 ERECTION

Install joists in conformance with SJI LOAD TABLES for the joist series indicated, and the requirements of 29 CFR 1926 and 29 CFR 1926.757. Handle and set joists avoiding damage to the members. Place the "tag end" of joists as shown on the joists placement plans. Ensure that square-end joists are erected right side up. Distribute temporary loads so that joist capacity is not exceeded. Remove damaged joists from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Do not repair, field modify, or alter any joists without specific written instructions from the Designer of Record and/or joist manufacturer.

Install and connect bridging concurrently with joist erection, before construction loads are applied. Do not apply loads to bridging. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams. Do not cut away vertical leg of bridging where bridging makes an elevation transition; weld a separate piece of bridging at the transition. Perform all welding in accordance with AWS D1.1/D1.1M.

3.2 BEARING PLATES

Provide bearing plates to accept full bearing after the supporting members have been plumbed and properly positioned, but prior to placing superimposed loads. The area under the plate must be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Provide bedding mortar and grout as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.3 PAINTING

3.3.1 Touch-Up Painting

After erection of joists, touch-up connections and areas of abraded shop coat with paint of the same type used for the shop coat.

3.3.2 Field Painting

Paint joists requiring a finish coat in conformance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

3.4 VISUAL INSPECTIONS

Perform the following visual inspections:

a. Verify that all joists are spaced properly.

b. Verify that there is sufficient joist bearing on steel beams, concrete, and masonry.

c. Verify all bridging lines are properly spaced and anchored.

d. Verify that damage has not occurred to the joists during erection.

e. Verify the joists are aligned vertically and there is no lateral sweep in the joists.

f. Where concentrated loads are present on the joists verify that they are located in accordance with the joists placement plan.

g. Verify welding of bridging and joist seats in accordance with AWS D1.1/D1.1M, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors.

h. Verify proper bolting of diagonal bridging and joist seats where the bolts are snug-tight.

## END OF SECTION 05 21 00

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# SECTION 05 30 00 - STEEL DECKS

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI D100 | (1991; R 2008) Cold-Formed Steel Design Manual |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel |
| AWS D1.3/D1.3M | (2008; Errata 2008) Structural Welding Code - Sheet Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A1008/A1008M | (2016) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened |
| ASTM A123/A123M | (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A36/A36M | (2014) Standard Specification for Carbon Structural Steel |
| ASTM A653/A653M | (2015; E 2016) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A780/A780M | (2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A792/A792M | (2010) Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process |
| ASTM D1056 | (2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber |
| ASTM D1149 | (2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber |
| ASTM D746 | (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact |
| ASTM E84 | (2016) Standard Test Method for Surface Burning Characteristics of Building Materials |

FM GLOBAL (FM)

| | |
|---|---|
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |
| FM DS 1-28R | (1998) Data Sheet: Roof Systems |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC Paint 20 | (2002; E 2004) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic) |

STEEL DECK INSTITUTE (SDI)

| | |
|---|---|
| ANSI/SDI QA/QC | (2011) Standard for Quality Control and Quality Assurance for Installation of Steel Deck |
| SDI DDMO3 | (2004; Errata 2006; Add 2006) Diaphragm Design Manual; 3rd Edition |
| SDI DDP | (1987; R 2000) Deck Damage and Penetrations |
| SDI MOC2 | (2006) Manual of Construction with Steel Deck |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2013; with Change 1) Structural Engineering |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1926 | Safety and Health Regulations for Construction |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 580 | (2006; Reprint Oct 2013) Tests for Uplift Resistance of Roof Assemblies |
| UL Fire Resistance | (2014) Fire Resistance Directory |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor QC approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; G

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Mechanical Fasteners

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

SD-05 Design Data

Deck Units; G

SD-07 Certificates

Powder-Actuated Tool Operator

Welder Qualifications

Welding Procedures

Fire Safety

Wind Storm Resistance

Manufacturer's Certificate

## 1.3 QUALITY ASSURANCE

### 1.3.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

### 1.3.2 Certification of Powder-Actuated Tool Operator

Provide manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

### 1.3.3 Qualifications for Welding Work

Follow Welding Procedures of AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding. Submit qualified Welder Qualifications in accordance with AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.4 Regulatory Requirements

*1.3.4.1 Fire Safety*

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Fire Resistance, or listing as Class I construction in the FM APP GUIDE, and so labeled.

*1.3.4.2 Wind Storm Resistance*

Provide roof construction assembly capable of withstanding a nominal uplift pressure of 90 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28R or as described in UL 580 and in general compliance with UFC 3-301-01.

1.3.5 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, cant strips, ridge and valley plates, metal closure strips, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

1.5.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

## PART 2 PRODUCTS

2.1 DECK UNITS

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

2.1.1 Roof Deck

Conform to ASTM A792/A792M or ASTM A1008/A1008M for deck used in conjunction with insulation and built-up roofing. Fabricate roof deck units of the steel design thickness required by the design drawings and zinc-coated in conformance with ASTM A653/A653M, Z275 G90 coating class or

aluminum-zinc coated in accordance with ASTM A792/A792M Coating Designation AZM165 AZ55. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

2.1.7 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

2.1.8 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

2.1.9 Touch-Up Paint

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M.

Provide touch-up paint for shop-painted units of the same type used for the shop painting, and touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

## 2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.0295 inch thick to close open ends at end walls, eaves, and openings through deck.

2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations.

2.2.4 Flexible Closure Strips for Roof Decks

Provide strips made of vulcanized, closed-cell, synthetic rubber material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Conforming to ASTM D1056, Grade 2A1, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F and tested in accordance with ASTM D1149.

Provide a elastomeric type adhesive as recommended by the manufacturer of the flexible closure strips.

2.2.6 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.7 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 18 gagethick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.8 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.9 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.10 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.11 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.

b. Slots or holes punched in decking for installation of pigtails.

c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.

d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.13 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inch wide, with top and bottom flanges a minimum 3 inch wide. Length of strips 10 feet.

2.2.14 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0358 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.2.15 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0358 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.2.16 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, and hot-dip galvanized in accordance with ASTM A123/A123M.

2.2.18 Mechanical Fasteners

Provide mechanical fasteners, such as pneumatically driven fasteners or self-drilling screws, for anchoring the deck to structural supports and adjoining units as indicated.

2.2.19 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch other metal accessories, 0.0358 inch unless otherwise indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

### 3.2 INSTALLATION

Install steel deck units in accordance with 29 CFR 1926, Subpart R – Steel Erection, ANSI/SDI QA/QC, SDI DDMO3 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap 2 inch deck ends. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 5/8 inchdiameter puddle welds, as indicated on the design drawings and in accordance with manufacturer's recommended procedure. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. Attachment of adjacent deck units by button-punching is prohibited.

*3.2.1.1 Welding*

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Conform to the recommendations of the Steel Deck Institute and the steel deck manufacturer for location, size, and spacing of fastening. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M finish with the manufacturer's standard touch-up paint.

*3.2.1.3 Sidelap Fastening*

Lock sidelaps between adjacent floor deck units together by welding or screws as indicated.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings 6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists.

3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

3.2.4 Touch-Up Paint

*3.2.4.1 Roof Deck*

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

3.2.5 Accessory Installation

*3.2.5.1 Adjusting Plates*

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

*3.2.5.2 End Closures*

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

*3.2.5.3 Closures Above Partitions*

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4-inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation.

*3.2.5.6 Access Hole Covers*

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

*3.2.5.7 Hangers*

Provide as indicated to support utility system and suspended ceilings. Space devices as indicated.

3.2.8 Preparation of Fire-Proofed Surfaces

Provide deck surfaces, both composite and non-composite, which are to receive sprayed-on fireproofing, galvanized and free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Complete any required cleaning prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

## 3.3 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

## 3.4 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12-inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4-inch on center.

## 3.5 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3-inch. For valley plates, provide endlaps to be in the direction of water flow.

## 3.6 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

## 3.7 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

## 3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

## 3.9 FIELD QUALITY CONTROL

### 3.9.2 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

### 3.9.3 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

**END OF SECTION 05 30 00**

# SECTION 05 50 13 - MISCELLANEOUS METAL FABRICATIONS

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 303 | (2010) Code of Standard Practice for Steel Buildings and Bridges |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2015; Errata 1 2015; Errata 2 2016) Structural Welding Code - Steel |

ASME INTERNATIONAL (ASME)

| | |
|---|---|
| ASME B18.2.1 | (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series) |
| ASME B18.2.2 | (2010) Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
| ASME B18.21.1 | (2009) Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series) |
| ASME B18.6.2 | (1998; R 2010) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series |
| ASME B18.6.3 | (2013) Machine Screws, Tapping Screws, and Machine Drive Screws (Inch Series) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A123/A123M | (2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A153/A153M | (2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| ASTM A307 | (2014) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength |
| ASTM A36/A36M | (2014) Standard Specification for Carbon Structural Steel |
| ASTM A500/A500M | (2013) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A53/A53M | (2012) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |

| | |
|---|---|
| ASTM A653/A653M | (2015; E 2016) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A780/A780M | (2009; R 2015) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A924/A924M | (2016a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| ASTM C1513 | (2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections |
| ASTM D1187/D1187M | (1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 79 | (Oct 2009) Alkyd Anti-Corrosive Metal Primer |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC SP 3 | (1982; E 2004) Power Tool Cleaning |
| SSPC SP 6/NACE No.3 | (2007) Commercial Blast Cleaning |

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

## 1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

## 1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Structural Carbon Steel

ASTM A36/A36M.

#### 2.1.2 Structural Tubing

ASTM A500/A500M.

#### 2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

#### 2.1.7 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

##### *2.1.7.4 Bolts, Nuts, Studs and Rivets*

ASME B18.2.2 or ASTM A307.

##### *2.1.7.6 Screws*

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

##### *2.1.7.7 Washers*

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

### 2.2 FABRICATION FINISHES

#### 2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

#### 2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

#### 2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which

stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

*2.2.4.1 Surface Preparation*

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

*2.2.4.2 Pretreatment, Priming and Painting*

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

### 3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

### 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts and expansion shields, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

## 3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

## 3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

## 3.6 FINISHES

### 3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

**END OF SECTION 05 50 13**

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# TECHNICAL SPECIFICATIONS

# DIVISION 06
# WOOD, PLASTICS, AND COMPOSITES

# SECTION 06 10 00 - ROUGH CARPENTRY

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes rough carpentry for:

1. Wood grounds, nailers, and blocking.

2. Decay and termite resistant wood treatment.

B. Related Sections include the following:

1. Division 5 Section “Metal Decking” for pressure treated nailers for roofing.

2. Division 7 Section “Standing Seam Metal Roof Panels” for nailers and blocking for metal roofing.

3. Division 7 Section “Flashing and Sheet Metal” for backing nailers and blocking for sheet metal.

1.02 QUALITY ASSURANCE

A. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:

1. American Forest & Paper Association (AFPA):

a. Manual for Wood Frame Construction.

2. American Lumber Standards Committee (ALSC):

a. Board of Review.

3. APA - The Engineered Wood Association (APA):

a. APA Standard Grading Rules.

b. Form No. E30K - APA Design/Construction Guide: Residential & Commercial.

4. American Society for Testing and Materials (ASTM):

a. Reference Standards.

5. American Wood Preservers’ Association (AWPA):

a. Reference Standards.

6. Federal Specifications (FS):

a. Reference Standards.

7. U.S. Department of Commerce (DOC), National Institute of Standards and Technology:

a. Referenced Product Standards (PS).

8. Southern Pine Inspection Bureau (SPIB):

a. SPIB Standard Grading Rules.

9. West Coast Lumber Inspection Bureau (WCLIB):

a. WCLIB Standard Grading Rules.

10. Western Wood Products Association (WWPA):

a. WWPA Standard Grading Rules.

b. Recommended Nailing Schedule.

1.03 SUBMITTALS

A. Product Data for Treated Lumber: Submit treatment plant's data showing the lumber type, certification by the treating plant stating chemicals and process used, net amount of treatment retained, and conformance with applicable standards. Include a statement that moisture content of treated materials was reduced to a maximum of 19 percent prior to shipment to the Site.

B. Calculations: Provide calculations for the type, size, length and minimum embedment depth of fasteners required for wood furring and plywood walls used to support the wall mounted equipment. Calculations shall be signed and sealed by a professional engineer currently registered in the State of Florida.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Maintain materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

B. For lumber and plywood pressure treated with waterborne chemicals, provide space between each course to provide air circulation.

1.05 PROJECT CONDITIONS

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, plates, blocking, grounds and similar supports to allow attachment of other work.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Lumber Standards, General:

1. Manufacture lumber to comply with DOC PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by ALSC Board of Review.

2. Factory mark each piece of lumber with grade stamp of inspection agency evidencing

compliance with grading rule requirements and identifying grading agency, grade species, moisture content at time of surfacing, and mill.

3. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by DOC PS 20, for moisture content specified for each use.

4. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

B. Grounds, Blocking, Nailers, Blocking, and Similar Members:

1. Grounds, nailers, blocking, and similar members shall be standard grade light framing size lumber of any species or board size lumber as required. No. 2 Common or Standard grade boards per WCLIB or WWPA rules, or No. 2 boards per SPIB rules.

C. Plywood Wall Sheathing Panels:

1. Comply with DOC PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood panels and, for products not manufactured under PS 1 provisions, with APA Form No. E30K.

2. Factory mark each construction panel with APA trademark evidencing compliance with grade requirements.

3. Exposure 1 exterior plywood with a minimum thickness of 5/8 inch.

D. Fasteners and Anchorages:

1. Provide size, type, material, and finish as indicated and as recommended by applicable standards, complying with applicable Federal Specifications for nails, staples, screws, bolts, nuts, washers, and anchoring devices. Provide metal hangers and framing anchors of the size and type recommended by the manufacturer for each use including recommended nails.

2. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners and anchorages with a hot-dip zinc coating pursuant to ASTM A 153.

E. Decay and Termite Resistant Wood Treatment:

1. All lumber and plywood specified for decay and termite resistant treatment shall be pressure treated according to AWPA Standard P-5 and FS TT-W-550. Preservatives containing arsenic are NOT acceptable.

2. Products: Provide one of the following treatments:

a. “Natural Select” copper azole preservative; Arch Wood Protection, Inc.

b. “Preserve” ACQ; Chemical Specialties, Inc.

c. “NatureWood"; Osmose, Inc.

2.02 WOOD TREATMENT

A. Decay and Termite Resistant Wood Treatment: Chemicals shall be applied in a closed cylinder by vacuum-pressure process in strict accordance with manufacturer’s instructions and with the

approved standards and recommended treating practices as listed in AWPA Standards C2 and C9 or the appropriate AWPA standard covering the commodity treated and as listed in FS TT-W-571.

1. After treatment and before shipment, lumber 2" nominal or less shall be dried to a 15-19 percent moisture content.

2. Plywood shall be dried after treatment and before shipment to moisture content of 18 percent or less.

3. Surfaces of wood that are to be exposed or painted shall be free from sludge or deposits of salts that would affect its paintability.

B. Provide decay (termite) treatment of the following lumber:

| Location | Treatment (General) |
|---|---|
| Wood members and plywood panels in contact with concrete, used in connection with roofing, or exposed to moisture | Decay (Termite) |

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which rough carpentry work is to be installed. Do not proceed with rough carpentry work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Material with defects, which might impair the quality of the work, and units which are too small to fabricate with a minimum of joints or the optimum joint arrangement, shall be discarded.

2. All rough carpentry work shall be set accurately to required levels and lines, with members plumb and true, and accurately cut and fitted.

3. All rough carpentry work shall be securely attached to substrates by anchoring and fastening as shown, and as required for structural adequacy.

4. Fasteners shall be of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Tight connections shall be made. Fasteners shall be installed without splitting of wood; predrill as required.

5. Use washers where required for fasteners to avoid movement of material through loading and/or vibration.

6. Seal cut ends where exposed to moisture or where moisture could migrate via gravity, capillary action, expansion or pressure gradients.

B. Wood Grounds, Nailers, and Blocking:

1. Wood grounds, nailers, and blocking shall be installed where indicated on the Drawings, and wherever required for screeding or attachment of other work. Shapes shall be formed

as shown and cut as required for true line and level of work to be attached.

2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork prior to concrete placement.

C. Plywood Wall Sheathing Panels:

1. Comply with applicable recommendations contained in APA Form No. E 30K for types of plywood panels and applications indicated.

2. Fastening Methods: Fasten panels as follows, in strict accordance with the Florida Building Code:

a. Backing Panels: Nail and/or screw to supports, as applicable.

## END OF SECTION 06 10 00

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# TECHNICAL SPECIFICATIONS

# DIVISION 07
# THERMAL AND MOISTURE PROTECTION

# SECTION 07 13 20 - SELF-ADHERING SHEET UNDERLAYMENT

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Self-adhering sheet underlayment for standing seam metal roof panels as indicated on the Drawings.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for pressure treated wood nailers, blocking, and sheathing required for roofing work.

2. Division 7 Section “Roof and Deck Insulation” for composite insulation system for metal roofing.

3. Division 7 Section “Standing Seam Metal Roof Panels” for metal roof panels and related attachments.

4. Division 7 Section “Flashing and Sheet Metal” for sheet metal flashing, coping, and sheet metal closures for roofing work.

1.02 SUBMITTALS

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

B. Samples for Verification: For the following products, of sizes indicated, to verify color selected.

1. Self-Adhering Underlayment: 12 inches square.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain self-adhering sheet underlayment through one source from a single underlayment manufacturer.

B. Fire-Test-Response Classification: Provide underlayment with the fire-test-response characteristics indicated, as determined by testing identical products per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, or UL 790, for application and roof slopes indicated.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store underlayment rolls on end on pallets or other raised surfaces. Do not double-stack rolls.
1. Handle, store, and place materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.05 PROJECT CONDITIONS

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

1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

**PART 2 - PRODUCTS**

2.01 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970, minimum of 40 mil thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.

1. Basis of Design: “Grace Ice and Water Shield”; W.R. Grace & Co., or approved equal.

**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.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored.

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

3.02 UNDERLAYMENT INSTALLATION

A. Install self-adhering sheet underlayment in accordance with manufacturer’s written instructions. Install at locations indicated on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces (if occurring) to receive self-adhering sheet underlayment.

**END OF SECTION 07 13 20**

# SECTION 07 22 00 - ROOF AND DECK INSULATION

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Rigid polyisocyanurate roof and deck insulation faced GFR on both major surfaces.
2. Cover board faced with CGF surfaces over ridged insulation board for standing seam metal roof panels as indicated on the Drawings.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for pressure treated wood nailers, blocking, and sheathing required for roofing work.

2. Division 7 Section “Self-Adhering Sheet Underlayment” for underlayment sheet for metal roofing.

3. Division 7 Section “Standing Seam Metal Roof Panels” for metal roof panels.

4. Division 7 Section “Flashing and Sheet Metal” for sheet metal flashing, coping, and sheet metal closures for roofing work.

1.02 SUBMITTALS

A. Product Data: Manufacturer’s specifications, installation instructions, and product data sheets for insulation board and related accessories..

B. Shop Drawings: Roof plan showing layout of boards and fastening patterns.

C. Samples: 6” x 6” of proposed board and related fasteners.

D. Thermal Warranty:

1. Submit sample warranty indicating conditions and limitations.

1.03 CODE/STANDARD COMPLIANCE

A. Product Compliance: The roof and deck insulation shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.

B. UL Class A Roof System requirements and FMG Class I Roof System for designated wind load per FMG Loss Prevention Data Sheet 1-28, “Wind Loads to Roof Systems and Roof Deck Securement.”

C. Comply with the following testing procedures:

1. Florida Building Code Test Protocol TAS 105-Test Procedure for Field Withdrawal Resistance Testing.

2. Florida Building Code Test Protocol TAS 114-Test Procedures for Roof System as the High Velocity Hurricane Zone Jurisdiction.

a. Appendix A- Test Procedure for Above Deck Combustibility ASTM E 108.

b. Appendix C-Test Procedure for Simulated Uplift Pressure Resistance of Roof System Assemblies.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Company specializing in manufacturing products specified in this Section with minimum 10-years documented experience.

B. Installer Qualifications: Company specializing in the installation of products specified in this Section with minimum 5-years documented experience using products of same type and scope as used for this Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in packages labeled with material name, thermal value and product code.

B. When stored outdoors or on the Project site, insulation shall be stacked on pallets at least 3-inches above ground level and completely covered with a waterproof covering. The temporary factory-applied packaging shall be slit or removed to prevent accumulation of condensation. Insulation which has become wet or damaged shall be removed and replaced with solid, dry insulation.

1.06 PROJECT CONDITIONS

A. Sequencing: Coordinate with metal roofing installer and roof and deck insulation manufacturer's installation instructions.

B. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by roof and deck insulation manufacturer for optimum results. Do not install products under environmental conditions outside roof and deck insulation manufacturer's limits.

**PART 2 - PRODUCTS**

2.01 ROOF AND DECK INSULATION

A. Roof insulation Basis of Design: ACFoam®-II GRF Roof insulation, flat closed-cell polyisocyanurate (polyiso) foam core, as manufactured by Atlas Roofing Corporation, or approved equal.

B. Cover board shall conform with applications for securing standing seam metal roofing system and provide 3/4" thickness.

C. Roof and deck insulation shall be constructed as follows:

1. Panel Area (Size): 4-foot x 8-foot.

2. Polyisocyanurate Insulation, thickness as required to achieve R value of R-30 minimum.

D. Roof and deck insulation shall conform to the following:

1. ASTM C 1289, Type V.

2. UL Standard 1256 Classification; Construction No. 120, 123 & 458.

3. UL Standard 790 (ASTM E 108): For use with Class A, B or C Shingles, Metal or Tile Roof Coverings.

4. FM Standard 4450 & 4470 Approved (1-90, 1-105); Approved for Class 1 Insulated Roof Deck Construction.

5. State of Florida Product Approval: FL17989.

6. Dimensional Stability: ASTM D 2126: <2%.

7. Compressive Strength: ASTM D 1621: 25 psi.

8. Water Absorption: ASTM C 209 (<1.5%).

9. Water Vapor Transmission: ASTM E96: <1.0 perm.

10. Product Density: ASTM D 1622: Nominal 2.0 pcf.

11. Flame Spread: ASTM E 84 10 min.: 40-60.

12. Smoke Developed: ASTM E 84 10 min.: 50-170.

13. Tensile Strength: ASTM D 1623: 730 psf.

14. Service Temperature: -100-degrees F to +250-degrees F.

D. Fasteners:

1. Manufacturer's engineered fastener for insulation and cover board in material, length, thickness, coating as recommended by manufacturer for applicable condition.

## PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine metal roof deck substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored.

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

3.02 INSTALLATION

A. Install roof and deck insulation in accordance with manufacturer's written instructions. Use approved mechanical fasteners as required by governing code requirements.

B. Install with end joints staggered to avoid having insulation joints coinciding with joints in deck.

3.03 PROTECTION

A. Remove trash and construction debris from insulation surface prior to application of roofing membrane.

B. Do not leave installed insulation exposed to weather. Cover and waterproof completed roof system immediately after installation.

1. Temporarily seal exposed insulation edges at the end of each work day.

2. Remove and replace installed insulation that has become wet or damaged with new insulation.

## END OF SECTION 07 22 00

# SECTION 07 24 19 – EXTERIOR BOARD INSULATION

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Rigid polyisocyanurate drainage-wall assemblies that are field applied over substrate.

2. Water-resistive coatings.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealing joints in exterior insulated finish system with elastomeric joint sealants and for perimeter joints between system and other materials.

2. Division 9 Section “Portland Cement Stucco” for finish system.

1.02 SUBMITTALS

A. Product Data: Manufacturer’s specifications, installation instructions, and product data sheets for insulation board and related accessories.

B. Shop Drawings: Wall plan showing layout of boards and fastening patterns.

C. Samples: 6” x 6” of proposed board and related fasteners.

D. Thermal Warranty:

1. Submit sample warranty indicating conditions and limitations.

1.03 CODE/STANDARD COMPLIANCE

A. Product Compliance: The wall insulation shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.

B. ASTM C591 Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

C. ASTM C272 / C272M Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions

D, ASTM D1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Company specializing in manufacturing products specified in this Section with minimum 10-years documented experience.

B. Installer Qualifications: Company specializing in the installation of products specified in this Section with minimum 5-years documented experience using products of same type and scope as used for this Project.

1.05 MANUFACTURER'S DETAILS

A. Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details.

1.06 PRODUCT DATA

A. Include data for material descriptions, recommendations for product shelf life, requirements for protection board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in packages labeled with material name, thermal value and product code.

B. When stored outdoors or on the Project site, insulation shall be stacked on pallets at least 3-inches above ground level and completely covered with a waterproof covering. The temporary factory-applied packaging shall be slit or removed to prevent accumulation of condensation. Insulation which has become wet or damaged shall be removed and replaced with solid, dry insulation.

1.06 SAFETY PRECAUTIONS

A. Comply with the safety requirements of ASTM C930.

1.07 SPECIAL WARRANTIES

A. Guarantee insulation installation against failure due to ultraviolet light exposure for a period of three years from the date of Beneficial Occupancy. Submit draft and final guarantees in accordance with CLOSEOUT SUBMITTALS and OPERATION AND MAINTENANCE DATA.

B. Provide manufacturer's material warranty for all system components for a period of three years from the date of Beneficial Occupancy. Submit draft and final warranties in accordance with CLOSEOUT SUBMITTALS and OPERATION AND MAINTENANCE DATA.

**PART 2 - PRODUCTS**

2.01 EXTERIOR BOARD INSULATION

A. Provide thermal insulating materials as recommended by manufacturer for each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

1. Unfaced Preformed Rigid Polyisocyanurate Board: ASTM C591

B. Thermal Resistance

1. Wall R-6.0 per inch for insulation. Total of two (2) inches.

C. Fire Protection Requirements

1. Flame spread index of 75 or less when tested in accordance with ASTM E84.

2. Smoke developed index of 200 or less when tested in accordance with ASTM E84.

3. Provide insulated assemblies in accordance ICC IBC Chapter Fire and Smoke Protection

Features.

D. Other Material Properties

1. Provide thermal insulating materials with the following properties:

a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 10 pounds per square inch (psi) when measured according to ASTM D1621.

b. Water Vapor Permeance: Not more than 1.1 Perms or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.

c. Water Absorption: Not more than 2 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

E. Recycled Materials

1. Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

a. Polyisocyanurate/Polyurethane: 9 percent.

F. Prohibited Materials

1. Do not provide materials containing asbestos.

G. Protection Board or Coating

1. As recommended by insulation manufacturer.

H. Accessories

1. Adhesive

a. As recommended by insulation manufacturer.

2. Mechanical Fasteners

a. Corrosion resistant fasteners as recommended by the insulation manufacturer.

## PART 3 - EXECUTION

3.01 PREPARATION

A. Blocking Around Heat Producing Devices

1. Provide noncombustible blocking at all spaces between heat producing devices and the floors, ceilings and roofs through which they pass. Provide in accordance with ICC IBC Section 2111.12 Fireplace Blocking and with the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is placed above fixture or device, 24 inches above fixture.

b. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

3.02 INSTALLATION

A. Installation and Handling

1. Provide insulation in accordance with the manufacturer's printed installation instructions. Keep material dry and free of extraneous materials.

B. Electrical Wiring

1. Do not install insulation in a manner that would enclose electrical wiring between two layers of insulation.

C. Continuity of Insulation

1. Butt tightly against adjoining boards, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

D. Coordination

1. Verify final installed insulation thicknesses comply with thicknesses indicated, R-values specified herein, and with the approved insulation submittal(s).

3.03 INSTALLATION ON WALLS

A. Installation on Masonry Walls

1. Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Place boards in moderate contact with adjoining insulation without forcing and without gaps. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other utilities. Seal around cutouts with sealant. Install insulation in wall cavities so that it leaves at least a nominal 2 inch air space outside of the insulation to allow for cavity drainage.

3.04 PROTECTION

A. Remove trash and construction debris from insulation surface prior to application of finish system.
B. Do not leave installed insulation exposed to weather. Cover and waterproof completed wall system immediately after installation.

1. Temporarily seal exposed insulation edges at the end of each work day.

2. Remove and replace installed insulation that has become wet or damaged with new insulation.

**END OF SECTION 07 24 19**

# SECTION 07 26 16 – UNDER-SLAB VAPOR BARRIER

## PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes:

1. Under-slab vapor barrier located under all concrete floor slabs, including walks within building line, as indicated on the Drawings and specified herein.

B. Related Sections include the following:

1. Division 3 Section “Cast-In-Place Concrete” for concrete work.

2. Division 31 Section “Earthwork” for subgrade and compaction.

3. Division 31 Section “Termite Treatment” for subterranean termite control.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's published descriptive literature, including typical details and installation instructions, for vapor barrier membrane, mastic, and tape.

B. Samples: Submit three (3) 12-inch by 12-inch samples of vapor barrier membrane and 6 inch length samples of tape.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E1745 - 11Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

2. ASTM E1643- 11Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

B. Technical Reference - American Concrete Institute (ACI):

1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.04 DELIVERY AND STORAGE

A. Packaged Materials: Deliver materials in bundles, rolls, and sealed containers bearing the manufacturer's original labels. Store materials in an enclosed area free from contact with soil and weather, and maintain at not less than 50 degrees F for at least 24 hours before use. If material is dated for use or “shelf life” is indicated on the labels, all outdated material shall be removed from the Site.

## PART 2 - PRODUCTS

2.01 VAPOR BARRIER MATERIALS

A. Vapor Barrier Membrane: Comply with the following:

1. Membrane Material: Flexible plastic or plastic laminate membrane, minimum 15.0 mils in thickness.

2. Maintain permeance of less than 0.01 as tested in accordance with mandatory conditioning tests per ASTM E1745.

3. Products: Provide one of the following vapor barrier membranes:
   a. "Nervastral"; Nervastral, Inc.
   b. "Fiberweb 210 Underslab Vapor Barrier"; Fiberweb Division of Hammerbeam, Inc.
   c. "Moistop Underslab"; Fortiber Building Products.
   d. "Griffolyn Type 65G"; Reef Industries.
   e. Stego Industries, LLC.
   f. Or Approved Equal.

B. Mastic: Comply with the following:

1. Provide mastic compound as recommended by the membrane manufacturer.

C. Tape: Double-sided pressure sensitive tape with release paper. Suitable as a durable field seam around penetrations in the vapor barrier membrane and to join membrane sheets together

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which the under-slab vapor barrier is to be installed. Do not proceed with vapor barrier work until unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Apply directly to compacted earth base, under concrete slabs, one layer of the vapor barrier membrane. Maintain 6-inch side laps and 9-inch end laps; turn down membrane 12 inches at slab/wall intersections.

B. Laps shall be fully sealed with mastic in strict accordance with manufacturer's published instructions for application procedures and limitations for temperature and setting time.

C. Additional strips shall be used at penetrations of membrane to close openings in membrane. Set in mastic.

D. Extreme care and precaution shall be exercised after membrane has been applied to prevent punctures, tears, and other abuses. Should such vapor barrier damage occur, repair the membrane by application of a membrane patch, sized to lap 9-inches on all sides of the damaged area, and set in a full bed of mastic.

**END OF SECTION 07 26 16**

# SECTION 07 41 13 - STANDING SEAM METAL ROOF PANELS

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Standing seam metal roof panels and related attachments/accessories as indicated on Drawings and specified herein.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for pressure treated wood nailers, blocking, and sheathing required for roofing work.

2. Division 7 Section “Self-Adhering Sheet Underlayment” for underlayment sheet for metal roofing.

3. Division 7 Section “Roof and Deck Insulation” for composite insulation system for metal roofing.

4. Division 7 Section “Flashing and Sheet Metal” for sheet metal flashing, coping, and sheet metal closures for roofing work.

5. Division 7 Section “Roof Accessories” for roof curbs, equipment supports and expansions joint assemblies.

6. Division 7 Section “Joint Sealants” for sealing joints.

7. Division 7 Section “Metal Soffit Panels” for metal panels used in horizontals soffit applications.

1.02 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers’ standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft.

2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference

C. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference; 20 percent of positive design wind pressure, but not less than

6.24 lbf/sq. ft. and not more than 120.0 lbf/sq. ft.

2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

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

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 1.03 CODE/STANDARD COMPLIANCE

A. Product Compliance: The roofing system shall have a State of Florida Product Control Notice of Acceptance (NOA) and meet all requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.

B. UL Class A Roof System requirements and FMG Class I Roof System for designated wind load per FMG Loss Prevention Data Sheet 1-28, “Wind Loads to Roof Systems and Roof Deck Securement.”

C. Provide roof covering materials bearing UL Classification Marking on bundle, package and/or container indicating that materials have been produced under UL's Classification and Follow-up Service.

D. Comply with the following testing procedures:

1. Florida Building Code Test Protocol TAS 105-Test Procedure for Field Withdrawal Resistance Testing.

2. Florida Building Code Test Protocol TAS 114-Test Procedures for Roof System as the High Velocity Hurricane Zone Jurisdiction.

a. Appendix A- Test Procedure for Above Deck Combustibility ASTM E 108.

b. Appendix C-Test Procedure for Simulated Uplift Pressure Resistance of Roof System Assemblies.

## 1.04 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer’s responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of data for metal roof panels and accessories, including shop drawings, based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those indicated for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

D. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to metal roof panel assemblies.

1. Meet with Owner, Architect/Engineer, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories.

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Fascia, flashing and trim.

b. Gutters.

c. Downspouts.

2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified Professional Engineer currently registered in the State of Texas responsible for their preparation.

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

1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.

2. Fascia, Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.

3. Accessories: 12 inch long samples for each type of accessory.

D. Qualification Data: For Installer, professional engineer, and testing agency.

E. Field quality control inspection reports.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:

1. Metal Roof Panels: Include reports for air infiltration, water penetration, and structural performance.

G. Maintenance Data: For metal roof panels to include in maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation or handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instruction and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on shop drawings.

1.08 WARRANTY

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

1. Failures include, but are not limited to, the following:
   a. Structural failures, including rupturing, cracking, or puncturing.

   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 35 years from date of Substantial Completion.

C. Special Weathertightness Warranty for Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

2.01 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: Galvalume® ASTM A 792, AZ-50 coating designation, Grade 40; structural quality.

2. Profile/Surface/Color; Basis of Design: Englert® Series 2500 Panel System, or approved equal, 2-inches high, 16-inches wide, in color as indicated and/or as selected by Architect/Engineer and/or Owner.

3. Exposed Finishes: Apply the following coating, as specified or indicated on Drawings:

a. High-Performance Organic Finish: AA-C12C42R1x. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

(1) Fluoropolymer Two-Coat or Three-Coat System (to meet warranty requirements): Manufacturer's standard thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Provide full panels from ridge to eave with no horizontal joints.

2.02 UNDERLAYMENT MATERIALS

A. Refer to Section 07 13 20 – SELF-ADHERING SHEET UNDERLAYMENT and Section 07 22 00 – ROOF AND DECK INSULATION for substrate and underlayment materials.

B. Slip Sheet (if required): Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.03 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.

1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc-alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

3. Blind Fasteners: High-strength stainless steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.04 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fascias, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.

2. Clips: Minimum 0.0625 inch thick, stainless steel panel clips designed to withstand negative-load requirements.
3. Cleats: Mechanically seamed cleats formed from minimum 0.0250 inch thick, stainless steel.

4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascias, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96 inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches o.c., fabricated from same metal as gutters. Provide bronze or copper wire ball strainers at outlets. Finish gutters to match metal roof panels.

D. Downspouts: Formed from 0.0179 inch thick, aluminum-zinc alloy-coated steel sheet prepainted with coil coating; in 10 foot long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels.

2.06 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile for full length of panel.

C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

## PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

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

3.02 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment and building-paper slip on roof sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply from eave to ridge, in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.03 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge with no horizontal joints. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.

2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.

3. Provide metal closures at peaks, rake edges, and each side of ridge and hip caps.

4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.

5. Locate and space fastenings in uniform vertical and horizontal alignment to provide equal temperature movement.

6. Install ridge and hip caps as metal roof panel work proceeds.

7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Roof Panels: Use stainless steel fasteners for surfaces exposed to the exterior and galvanized steel for surfaces exposed to the interior. Touch up exterior fasteners with panel color.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

1. Coat back side of steel roof panels with bituminous coating where roof panels will contact wood, ferrous metal, or cementitious construction.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, sealants indicated or, if not otherwise indicated, types recommended by metal roof panel manufacturer.

1. Seal side joints as recommended by metal roof panel manufacturer.

2. Prepare joints and apply sealants to comply with requirements of Section 07 92 00 – JOINT SEALANT.

3.04 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Fascia, Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed fascia, flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded

back to form hems. Install sheet metal fascia, flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed fascia, flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Touch up cut edges with manufacturer's matching color.

3.05 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8 inch offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.

C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.08 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

## END OF SECTION 07 41 13

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# SECTION 07 60 00 - FLASHING AND SHEET METAL

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Sheet metal flashings, drip edges, fascia, downspouts, gutters, and all miscellaneous sheet metal work required for roofing and related work, complete as indicated on Drawings and by provision of this Section.

2. Include flush vented exterior soffit system and related attachments.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for pressure treated wood nailers, blocking, and sheathing required for roofing work.

2. Division 7 Section “Self-Adhering Sheet Underlayment” for underlayment sheet for metal roofing.

3. Division 7 Section “Roof and Deck Insulation” for composite insulation system for metal roofing.

4. Division 7 Section “Standing Seam Metal Roof Panels” for metal roofing system.

5. Division 7 Section “Joint Sealants” for sealing joints.

6. Division 9 Section “Painting” for finish coating.

1.02 QUALITY ASSURANCE

A. Installer's Qualifications: Flashing and sheet metal work shall be fabricated by a qualified sheet metal fabricator with at least five (5) years documented experience in installations of a similar nature.

B. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:

1. American Architectural Manufacturers Association (AAMA):

a. Referenced Standards.

2. American Society for Testing and Materials (ASTM):

a. Referenced Standards.

3. Factory Mutual Global (FMG):

a. Referenced Standards.

4. Federal Specifications (FS):

a. Referenced Standards.

5. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

a. Referenced Standards.

C. Performance Requirements:

1. Wind Uplift Resistance: Installation of all sheet metal work and soffit system shall comply with FMG 1-90 wind uplift requirements in FMG Loss Prevention Data Sheet 1-28, "Wind Loads to Roof Systems and Roof Deck Securement."

2. The assemblies shall conform to the Florida Building Code requirements for Certification of Exterior Products and Materials (Notice of Approval).

1.03 SUBMITTALS

A. Product Data: Submit complete product data, including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

B. Shop Drawings: Complete shop drawings shall be prepared for all flashing and sheet metal work fabrication, soffit system, assembly, and attachment details, size of all members, fastening devices, supports and anchors, patterns, clearances, and all necessary connections to work of other trades.

C. Installer's Qualifications: Submit documented evidence of installer's qualifications.

D. Warranty: Submit specimen copy of specified warranty.

1.04 HANDLING AND STORAGE

A. Sheet metal materials shall be carefully handled to prevent damage to surfaces, edges, and ends; and shall be stored at the site above the ground in a covered, dry location. Damaged items that cannot be restored to original condition will be rejected and shall be replaced at no additional cost to the Owner.

1.05 PROJECT CONDITIONS

A. Coordinate work of this Section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.06 WARRANTY

A. Finish Warranty: Provide manufacturer's standard fifteen (15) year written performance warranty.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Pre-Finished Galvanized (Hot-Dipped) Sheet Metal Material:

1. Pre-finished galvanized (hot-dipped) sheet metal drip edges, fascia, rain gutters and downspouts, and all miscellaneous sheet metal items indicated on Drawings shall be fabricated to shapes detailed on Drawings.

2. Galvanized steel sheet shall comply with ASTM A 653, G 90, commercial quality, for hot-dip galvanized steel sheet, mill phosphatized where indicated for painting. Provide

minimum 24 gauge material thickness, unless otherwise indicated on Drawings.

3. Pre-Finish:

a. Provide manufacturer's standard fluoropolymer 2-coat thermocured coating system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

(1) Color to be selected by Architect/Engineer and/or Owner.

b. Products, Resin Manufacturers: Provide fluoropolymer coating systems containing one of the following resins:

(1) "Hylar 5000"; Ausimont USA, Inc.
(2) "Kynar 500"; Atofina Chemicals, Inc.

B. Flush Vent Exterior Soffit System:

1. Basis of Design: PAC-CLAD Peterson Aluminum Flush Vented Exterior Soffit System, or approved equal, as follows:

a. Profile: 12” o.c. “Flush Vented,” 1-inch high panel conforming to ASTM E330.

b. Material: .032” Aluminum.

c. Finish: Prefinished Kynar 500 or Hylar 5000 (specified herein) in color selected by Architect/Engineer from manufacturer’s standard line.

2. Fasteners/Attachments: Manufacturer’s concealed fasteners and trim as required to meet code wind resistance.

2.03 FABRICATION

A. Shop fabricate work to greatest extent possible, with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work.

B. Form work to fit substrates. Comply with material manufacturer’s published instructions and current recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

## PART 3 - EXECUTION

3.01 PREPARATION

A. Surfaces that are to receive sheet metal work shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect their application.

3.02 INSTALLATION

A. Install sheet metal fabrications as required for the work.

B. Perform cutting, fitting, drilling, and other operations as required to complete the work. Accessories and other components necessary to complete the work, whether or not specifically indicated or specified, shall be provided. Where sheet metal abuts or extends into adjacent materials, the juncture shall be executed in a manner to ensure weathertight construction.

C. Manufactured items shall be installed in strict accordance with manufacturer's published instructions.

D. All surfaces exposed to view shall be installed using continuous cleats to provide no visible fasteners.

3.03 CLEAN UP

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

**END OF SECTION 07 60 00**

# SECTION 07 92 00 - JOINT SEALANTS

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Joint sealants and caulking as indicated on the Drawings and as specified herein.

B. Related Sections include the following:

1. Division 4 Section “Unit Masonry” for sealing joints in masonry construction.

2. Division 8 Section “Steel Doors and Frames” for sealing joints in steel door frames.

1.02 QUALITY ASSURANCE

A. Installer Qualifications: The Installer shall have a minimum of five (5) years continuous documented experience in the application of the types of materials required, and approved or licensed by the manufacturer to install elastomeric sealants required for this Project.

B. Product Testing: Obtain test results for test reports required as submittals from a qualified testing agency based on testing current sealant formulations within a 36 month period preceding commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

3. Test other joint sealants for compliance with requirements indicated by referencing standard specification and test methods.

C. Performance Requirements: Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

A. Product Data: Submit complete manufacturer's technical data for each manufactured item. Include the following:

1. Certification that each product to be furnished is recommended for the application shown.

2. Complete instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.

B. Samples: Submit the following samples:

1. One tube, in original sealed container, of each sealant specified.

2. 12 inch length of each joint filler specified.

C. Qualification Data: For Installer and testing agency.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

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

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.04 PRODUCT DELIVERY AND STORAGE

A. Deliver all products to the Project site undamaged, and in the manufacturer's original packing. Store products within the manufacturers' published temperature tolerances.

1.05 ENVIRONMENTAL CONDITIONS

A. Do not install joint sealant materials when the ambient and substrate temperatures are below 40 degrees F, unless the manufacturer specifically recommends application of materials at lower temperatures. If Project progress or any other condition requires installations when ambient and substrate temperatures are below 40 degrees F (or below the minimum installation temperature recommended by the manufacturer), consult the manufacturer's representative and establish the minimum provisions required to ensure satisfactory work. Record in writing to the manufacturer, with a copy to the Architect/Engineer, the conditions under which such installation must proceed, and the provisions made to ensure satisfactory work.

B. Do not proceed with installation of bulk compounds during inclement weather unless the full compliance with all requirements and manufacturer's published instructions.

C. Do not proceed with the installation of elastomeric sealants under extreme temperature conditions which would cause joint openings to be at either maximum or minimum width, or when such extreme temperatures or heavy wind loads are forecast during the period required for initial or nominal cure of elastomeric sealants. Whenever possible, schedule the installation and cure of elastomeric sealants during periods of mean temperatures (nominal joint width shown) so that subsequent stresses upon the cured sealants will be minimized.

1.06 WARRANTY

A. Special Project Warranty: Provide a written warranty, signed by the installer and Contractor, against defects materials and workmanship for joint sealants which fail to perform as airtight or watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in joint sealant manufacturer's published data as an inherent quality of the material for the exposure indicated.

1. Warranty Period: Five (5) years from the date of Final Acceptance.

## PART 2 - PRODUCTS

2.01 GENERAL

A. Hardnesses indicated and specified are intended to indicate the general range necessary for overall performance. The manufacturer's technical representative shall determine the actual hardness recommended for the conditions of installation and use. Except as otherwise indicated or recommended, compounds shall be provided within the range of hardness (Shore A, Fully cured, at 75 degrees F) of 25 to 40.

B. Prior to installation of each specified sealant, confirm its compatibility with the joint surfaces, joint fillers, and other materials in the joint system. Only materials that are known to be fully compatible with the actual installation conditions, as shown by manufacturer's published data or certification, shall be provided.

2.02 SEALANTS

A. Exterior Sealants: Sealants for exterior locations and all interior and exterior expansion joints shall be cold-applied elastomeric joint sealant, two-part polyurethane sealant complying with ASTM C 920.

1. Products, Horizontal Joints: Provide one of the following Type M (multicomponent), Class 25, Use T (traffic) sealants:

a. AUrexpan NR-200"; Pecora Corporation.

b. "Vulkem 245"; Tremco.

c. "Sonolastic SL 2"; Sonneborn, Div. of ChemRex Inc.

2. Products, Vertical Joints: Provide one of the following Type M (multicomponent), Class 25, Use NT (nontraffic) sealants:

a. "Dynatrol II"; Pecora Corporation.

b. "Vulkem 227"; Tremco.

c. "Sonolastic NP 2"; Sonneborn, Div. of ChemRex Inc.

B. Interior Sealants: Sealants for interior locations shall be acrylic latex sealant compound, non-staining, non-bleeding, paintable, complying with ASTM C 834.

1. Products: Provide one of the following sealants:

a. "AC-20+"; Pecora Corporation.

b. "Sonolac"; Sonneborn, Div. of ChemRex Inc.

c. "Tremflex 834"; Tremco.

2.03 MISCELLANEOUS MATERIALS

A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by the sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Backer Rods: Provide closed-cell, expanded polyethylene backer rods. The size and shape of the rod shall be that which will control the joint, form optimum shape of sealant bead on the back side, and provide a highly compressible backer to minimize the possibility of sealant extrusion

when the joint is compressed.

1. Basis of Design: "Ethafoam"; Dow Chemical Company.

2.04 COLORS

A. For concealed joints, provide manufacturer's standard color from the product that has the best overall performance qualities for the application shown. For exposed joints, the Architect/Engineer and/or Owner will select colors from the manufacturer's standard or premium line of colors from the product that provides the match to the materials.

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.

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

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer’s written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming of blowing out joints with oil-free compressed air.

3. Remove laitance and form-release agents from concrete.

4. Clean metal and similar nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint sealant manufacturer, based on prior experience. Apply primer to comply with joint sealant manufacturer’s written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

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

## 3.03 JOINT SEALANT INSTALLATION

A. General: Comply with joint sealant manufacturers' published instructions, unless more stringent requirements are shown or specified, or the manufacturer's technical representative recommends otherwise.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Prime or seal joint surfaces as indicated or recommended by the sealant manufacturer. Do not spill or allow primers or sealers to migrate onto adjoining surfaces.

D. Install sealant backer rods for all elastomeric sealants, unless indicated to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

E. Install bond breaker tape where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly, or as indicated on the Drawings.

F. Employ only proven installation techniques that will ensure sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Unless otherwise indicated, fill sealant joints to a slightly concave surface and slightly below adjoining surfaces. Where horizontal joints occur between a horizontal surface and a vertical surface, fill joints to form a slight cove, so that the joint will not trap moisture and dirt.

1. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

G. Install sealants to depths indicated, or if not indicated, as recommended by the sealant manufacturer, but within the following general limitations measured at the center (thin) section of the bead.

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposure, fill joints to a depth equal to 75 percent of the joint width, but neither more than 5/8 inch deep nor less than 3/8 inch deep.

2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, Fill joints to a depth equal to 50 percent of joint width, but not more than 3/8 inch nor less than 1/4 inch.

3. For joints sealed with non-elastomeric sealant compounds, fill joints to a depth in the range of 75 percent to 115 percent of the joint width.

H. Do not permit joint sealant materials (primers, sealers, or sealants) to spill onto adjoining surfaces, or be allowed to migrate into the voids of adjoining surfaces including rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces.

I. Promptly remove excess sealant from surfaces adjacent to joints as the work progresses. Clean adjoining surfaces as necessary to eliminate evidence of spillage, without damage to the adjoining surfaces or finishes.

## 3.04 CURE AND PROTECTION

A. Cure sealants in compliance with the manufacturer's published instructions and current recommendations to obtain high early bond strength, internal cohesive strength, and surface

durability.

B. The installer shall advise the Contractor of procedures required for the curing and protection of sealants compounds during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering), at the time of Final Acceptance.

**END OF SECTION 07 92 00**

# TECHNICAL SPECIFICATIONS

# DIVISION 08
# OPENINGS

# SECTION 08 11 13 - STEEL DOORS AND FRAMES

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Flush Steel Doors and frames.

B. Related Sections include the following:

1. Division 4 Section “Unit Masonry” for masonry work.

2. Division 7 Section “Joint Sealants” for elastomeric sealants.

3. Division 8 Section “Door Hardware” for operating hardware.

5. Division 9 Section “Painting” for finishing doors and frames.

1.02 QUALITY ASSURANCE

A. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.

B. Manufacturer/Fabricator: Steel doors and frames shall be manufactured by a single firm specializing in the production of this type of work.

C. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:

1. American National Standards Institute (ANSI):

a. Referenced Standards.

2. American Society for Testing and Materials (ASTM):

a. Referenced Standards.

3. Glass Association of North America (GANA):

a. Referenced Standards.

4. National Fire Protection Association (NFPA):

a. Referenced Standards.

5. Steel Door Institute (SDI):

a. SDI 100 Recommended Specifications for Standard Steel Doors and Frames.

b. SDI 105 Recommended Erection Instructions for Steel Frames.

D. Fire-Resistance Classifications: Where fire-resistance classifications are shown or scheduled for

steel doors and frame assemblies, the doors and frames shall comply with the requirements of NFPA 80, and shall have been tested and rated with the appropriate hardware by Underwriters Laboratories (UL). A UL label shall be provided on each door and frame so classified.

E. Wind Resistance: Exterior door assemblies shall comply with Florida Building Code Test Protocol TAS 201- Impact and Test Procedures and Test Protocol TAS 203 - Criteria for Testing Products Subject to Cyclic Wind Pressure Loading.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical information and installation instructions for each type of door and frame.

B. Shop Drawings: Submit shop drawings for steel doors and frames as follows, and as a package with submittals for other doors and finish hardware to enable a coordinated review of all door openings for the Project.

1. Submit shop drawings for the fabrication and installation of the steel doors and frames. Drawings shall include details of each frame type, elevations of door design types, louvers, conditions at openings, details of construction, location and installation requirements of finish hardware, and reinforcements and details of joints and connections, showing anchorage and accessory items.

2. Shop drawings shall indicate accurate dimensions of work shown. Frame returns shall allow for conditions (i.e. 5/8 inch gypsum board or exposed masonry as scheduled). Except where otherwise shown, 1/4 inch sealant space shall be provided for each jamb and head abutting wall materials.

3. Shop drawings shall list and locate all items of finish hardware furnished under other Sections of the Specifications, but prepared for by the manufacturer of hollow metal doors and frames, from templates provided by the hardware supplier.

C. Schedule:

1. A schedule of doors and frames shall be provided using the same opening numbers referenced on the Drawings and the same schedule format.

1.04 PRODUCT DELIVERY AND STORAGE

A. Doors and frames shall be protected during transit, storage, and handling to prevent damage, soiling, and deterioration.

B. Each door shall be packaged at the factory in a separate heavy paper carton. Each carton shall be marked for location to correspond with the Shop Drawings.

C. Ship welded frames in bundles securely strapped or in packages.

D. Store doors and frames at the building site under cover. Frames shall be stored in an upright position. Place the units on at least 4 inch wood sills or on floors in a manner that will prevent rust or damage. Avoid the use of nonvented plastic or canvas shelters that create a humidity chamber. If the wrapper on the door becomes wet, remove the carton immediately. Provide a 1/4 inch air space between the doors to promote air circulation.

1.05 PROJECT CONDITIONS

A. Field Measurements: Obtain and verify all measurements at the buildings as required to properly

fabricate and install all special door and frame requirements if and when they occur. Verify all conditions that may affect door installation.

## PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products: Provide one of the following:

1. "Lock Seam Design"; American Steel Products.

2. "Series HT"; Pioneer Industries, Inc.

3. "Series LW"; Steelcraft/Ingersoll Rand.

4. Or approved equal

2.02 MATERIALS AND FABRICATION

A. Pressed Steel Frames:

1. Frames shall be double rabbeted design, depth and profile as detailed and furnished with minimum 5/8 inch stop. Frames shall be fabricated from 14 gauge (exterior openings) and 16 gauge (interior openings) commercial quality, level, cold-rolled steel conforming to ASTM A 1008 or hot-rolled, pickled and oiled steel conforming to ASTM A 1011.

2. Frames shall have zinc coating applied by hot-dip process conforming to ASTM A 653 (G60) with coating weight not less than 0.60 oz. per square foot (0.30 oz. per square foot per side). Frames shall be designed with integral stop and trim.

3. Frame corners shall be mitered and continuously arc welded (both inside of mitered corners and butt edges) with all exposed welds ground and sanded smooth. Mitered corners shall be reinforced with 18-gauge channel-shaped reinforcements.

4. Head members shall be 2 inches high unless otherwise indicated.

5. Strike jambs shall be provided with three (3) holes for rubber bumpers (silencers); refer to Section 08 71 00 - DOOR HARDWARE for furnishing and installation of silencers.

6. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

7. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

B. Steel Doors:

1. Hollow metal steel doors shall be fabricated from 18 gauge commercial quality, level, cold-rolled steel conforming to ASTM A 1008 or hot-rolled, pickled and oiled steel conforming to ASTM A 1011. Face sheets for doors shall have zinc coating applied by hot-dip process conforming to ASTM A 653 (G60) with coating weight not less than 0.60 oz. per square foot (0.30 oz. per square foot per side).

2. Door face sheets shall be 1-3/4 inches thick heavy-duty, full flush hollow steel formed from one sheet of metal with no seams permitted on the door face. Lock seam shall occur

on hinge edge with seam continuously welded and welds ground smooth. Tops shall be flush and closed with no holes. Top and bottom of door shall be closed with a minimum 16 gauge flush or inverted closure channel.

3. A full-width dense rigid polyurethane core conforming to ASTM C 591 shall be installed in all doors to provide dimensional stability, insulated r-value, and high resistance to facial impact.

4. The clearances for doors shall be 3/32- to 1/8-inch at jambs and heads. The lock edges of stiles shall be beveled 1/8 inch in 2 inches for steel doors.

5. The top and bottom edges of all exterior steel doors shall be closed to provide a weather seal. This seal shall be provided as part of the door construction or by the addition of inverted steel channels or other suitable shapes welded, caulked and sealed to the face sheets and formed (shaped) so the assembly will not retain water.

6. All exterior double doors shall have a steel astragal attached to the active leaf.

7. Louvers shall be manufacturer's standard sightproof stationary louvers constructed of inverted V-shaped or Y-shaped blades formed of 18 gauge cold-rolled galvanized steel set into 18-gauge galvanized steel frame. Use type louver for exterior doors as recommended by door manufacturer.

   a. Provide manufacturer's standard insect and bird screen backup for all louvers and louvered doors. Screens shall be removable for maintenance and cleaning.

C. Labeled Steel Doors and Frames:

1. Where indicated on Drawings, furnish UL Labels with appropriate fire resistance ratings for the class of opening specified. Both doors and frame shall have label attached. Construction details and hardware application shall be as approved by the labeling authority.

2. All approved fire doors shall be arranged to either remain in normally closed position with suitable self-closing device or in normally open position with a fusible element or smoke detector actuated mechanism which will close the door automatically in case of fire, as indicated on Drawings and/or as required by governing authorities.

3. Pairs of UL label fire doors shall have an overlapping steel astragal welded or bolted to the active leaf.

4. The clearances for fire doors shall be as required by the authority having jurisdiction.

5. Louvers shall be door manufacturer's standard as specified above under Paragraph 2.02, B.7.; equipped with UL approved fusible link fire damper for label required.

D. Metal Finishes:

1. Shop Applied Primer Finish:

   a. Apply a primed finish to all galvanized and non-galvanized metal surfaces furnished under this Section. Clean and chemically treat metal surfaces to assure maximum paint adhesion; follow with a dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces.

b. Finished surfaces shall be smooth and free from irregularities and rough spots. Paint shall be baked or oven dried. the time and temperature for drying shall be in accordance with manufacturer's recommendations for developing maximum hardness and resistance to abrasion.

2. Field Paint Finish: Finish painting of steel doors and frames is specified under Section 09 91 00 - PAINTING.

E. Hardware Provisions and Reinforcing:

1. Hardware Provisions for Pressed Steel Frames:

a. Unless a different strike is noted on Hardware Schedule, frames shall have steel hinge plate reinforcement projection welded with provisions for 4-1/2 inch x 4-1/2 inch full mortise type hinges and steel strike tap plate reinforcement projection welded with provisions for Universal ANSI A115.1 or A115.2 strike.

b. Frames shall be provided for 1-1/2 pair of hinges, unless noted otherwise. Mortar guards shall be formed from 26-gauge galvanized steel and shall be welded in place.

c. Closer reinforcement shall be sleeve type installed in frame header for all doors that are indicated to receive door closers.

d. Provide metal reinforcements for all other hardware items indicated.

e. Minimum gauges of hardware reinforcing plates shall be as follows:

| | | |
|---|---|---|
| (1) | Hinge Reinforcements: | 8 gauge, 1-1/4 x 10-inch min. size. |
| (2) | Lock Reinforcements: | 12 gauge. |
| (3) | Closer Reinforcements: | 12 gauge. |
| (4) | Surface-Mounted Hardware: | 12 gauge. |

2. Hardware Provisions for Steel Doors:

a. Mortise, reinforce, drill and tap doors at the factory to receive all mortised type hardware. Drilling and tapping for surface applied hardware shall be performed in field. Provide concealed metal reinforcement for surface applied hardware indicated in the Hardware Schedule.

b. Doors shall have steel integral hinge reinforcement with provisions for 4-1/2 inch x 4-1/2 inch full mortise template type hinges for 1-1/2 pair of hinges per door, unless noted otherwise.

c. Doors shall have steel integral lock reinforcement with provisions for locksets as indicated.

d. Doors shall have steel closer reinforcement concealed in the door for all doors that are indicated to receive closers.

e. Minimum gauges for hardware reinforcing plates shall be as follows:

| | | |
|---|---|---|
| (1) | Hinge Reinforcements: | 8 gauge. |
| (2) | Lock Reinforcements: | 12 gauge. |
| (3) | Closer Reinforcements: | 12 gauge. |
| (4) | Surface Mounted Hardware: | 16 gauge. |

F. Location of Hardware: The location of hardware in connection with hinged and other swing type hollow metal doors and frames shall be as follows, unless indicated or specified otherwise:

1. Top Hinge: To manufacturer's standard, but not greater than 5 inches from head rabbet to top of hinge.

2. Bottom Hinge: To manufacturer's standard but not greater than 10 inches from finish floor to bottom of hinge.

3. Intermediate Hinge: Equally spaced between top and bottom hinge.

4. Locks (cylindrical, mortise, unit or integral): 38 inches from finish floor to center of strike.

5. Refer to Section 08 71 00 - DOOR HARDWARE for additional locations.

G. Frame Anchors:

1. All frames shall have an integral or welded on sill anchor.

2. Furnish eight (8) per frame, 10 inch long corrugated or other deformed type adjustable anchors as condition applies.

2.03 FABRICATION

A. All work shall be shop fabricated to required profiles by forming and welding with corners, angles and edges straight and sharp.

B. Fit and fabricate accurately with corners, joints, seams and surfaces free from warp, buckles or other defects.

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which steel doors and frames are to be installed. Do not proceed with steel door and frame installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install standard steel doors, frames and accessories in accordance with approved shop drawings, manufacturer's data and as herein specified.

B. Steel Frames:

1. Comply with provisions of SDI 105, unless otherwise indicated.

2. Except for frames located at in-place drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

3. In masonry and cast-in-place concrete construction, wall anchors shall be located at the hinge and strike levels, and frames shall be grouted solid (Jambs and Heads).

4. Install fire-rated frames in accordance with NFPA 80.

5. In concrete construction, locate four (4) wall anchors per jamb at hinge and strike levels.

C. Steel Doors:

1. Fit steel doors accurately in frames, within clearances specified in SDI 100.

2. Place fire-rated doors with clearances as specified in NFPA 80.

3.03 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after installation, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

C. Cleaning: Immediately prior to final inspection and before Final Acceptance, remove all protective materials and clean all exposed members. Do not use abrasives or harmful cleaning agents.

## END OF SECTION 08 11 13

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# SECTION 08 71 00 - DOOR HARDWARE

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Finish hardware for doors as shown on the Drawings, indicated on schedules, and as specified herein.

2. Hardware for labeled openings shall meet UL requirements whether specified herein or not.

3. All hardware on accessible doors shall meet or exceed the requirements of the Americans with Disabilities Act (ADA) whether or not full compliance is indicated in the Hardware Schedule located at the end of this Section.

B. Related Sections include the following:

1. Division 6 Section “Rough Carpentry” for rough hardware related to carpentry.

2. Division 8 Section “Steel Doors and Frames” for Steel doors to receive door hardware.

1.03 QUALITY ASSURANCE

A. Code Compliance: Total installation must comply with the requirements of the Florida Building Code, current edition in force, including Test Protocols for High Velocity Hurricane Zones.

B. Approved Products: As applicable, products used herein shall comply with requirements of the Florida Product Approval System as required by Florida Statute 553.842 and Florida Administrative Code 9B-72.

C. Reference Standards: Comply with provisions of the latest adopted editions of the following:

1. Door and Hardware Institute (DHI):

a. Referenced Standards.

2. National Fire Protection Association (NFPA):

a. NFPA 80 Fire Doors and Fire Windows.

b. NFPA 101 Life Safety Code.

B. Installer Qualifications: An experienced installer who has completed finish hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

1.04 SUPPLIER QUALIFICATIONS

A. Finish Hardware shall be furnished by one supplier, approved by the Architect/Engineer, with appropriate technical knowledge and experience to correctly interpret Drawings and Specifications. Supplier shall be prepared at all times during progress of installation to promptly provide a qualified Architectural Hardware Consultant (AHC) to approve its complete installation,

in order that all items shall be installed in the best manner and function properly. This will necessitate a project site visit prior to final inspection. Supplier shall be bona-fide direct distributor of all materials furnished.

B. It shall be the supplier's responsibility to furnish hardware in accordance with the intent of this specification. Where, by virtue of architectural design or by function, a change is necessary, hardware of equal design and quality shall be furnished upon written approval of Architect/Engineer.

1.05 SUBMITTALS

A. Product Data: Submit complete product data for each item of finish hardware listed in the Finish Hardware Schedule. Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Finish Hardware Schedule: Submit complete typewritten sets of the Finish Hardware Schedule. Organize the Hardware Schedule into door hardware sets indicating complete designations of every item required for each door. Organize door hardware sets in the same order as in Article 3.03 - FINISH HARDWARE SCHEDULE. No factory order shall be placed for finish hardware items until approval has been given by the Architect/Engineer.

1. Each item in the Finish Hardware Schedule shall be identified on the first page of the Schedule by the manufacturer’s name.

C. Keying Schedule: Submit a keying schedule prepared by the supplier, detailing the Owner’s keying instructions for locks. Include a schematic keying diagram and index each key to unique door designations. Refer to keying schedule at the end of this Section for additional information.

D. Supplier Qualifications:

1. Submit documented evidence of supplier’s qualifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All items of finish hardware shall be delivered to the Project site, or as otherwise specified or required, and shall be checked in for completeness and familiarization with the Contractor.

B. All items of finish hardware shall be packaged, numbered, and labeled to identify each opening for which it is intended, and to correspond with item numbers on the approved Finish Hardware Schedule.

1.08 COORDINATION

A. Templates: All finish hardware to be installed on, or in metal doors and/or frames, shall be manufactured to template. Template machine screws shall be furnished for all such materials. Supplier shall furnish an approved Finish Hardware Schedule and all necessary template transmittals to metal frame fabricators, or other suppliers requiring same, for their coordination and use.

## PART 2 - PRODUCTS

2.01 GENERAL

A. An asterisk (*) after a manufacturer's name denotes whose product designation is used in the Finish Hardware Schedule for purposes of establishing minimum requirements.

B. Other than those doors that are restricted to less than 180 degree opening by building or by overhead holders or stops, all butts and closer arms shall be of sufficient size to allow full 180-degree opening of doors.

2.02 FINISHES

| | | |
|---|---|---|
| A. | Butts - Exterior: | US32D |
| B. | Butts - Interior: | US26D |
| C. | Locks: | US32D |
| D. | Closers: | SBL |
| E. | Door Stops and Miscellaneous: | US26D |

2.03 LOCATIONS

A. Hardware locations dimension shall be as follows:

1. Distance from finish floor to center line of:

| | | |
|---|---|---|
| a. | Door Knob or Lever: | 38 inches. |
| b. | Door Pull: | 42 inches. |
| c. | Deadlock: | 60 inches. |

2. Butt Hinges:

| | | |
|---|---|---|
| a. | Bottom Hinge: | Finish floor to bottom of hinge 10 inches. |
| b. | Top Hinge: | Head rabbet to top of hinge 5 inches. |
| c. | Center Hinge: | Equidistant between top and bottom hinges. |

2.04 BUTT HINGES

A. Doors (1-3/4 Inch Thick): Minimum 4-1/2 inches high.

B. Each door shall not have less than three hinges.

C. All butts used with door closers shall be ball bearing. All exterior doors shall have ball bearing butts, except as otherwise specified.

D. All exterior out-swinging doors shall have butts with non-removable pins (NRP).

E. Products: Provide butt hinges by one of the following manufacturers:

1. Hager Companies.*
2. Stanley Commercial Hardware Div. of The Stanley Works.
3. McKinney Products Co. Div. of ESSEX Industries, Inc.
4. Lawrence Brothers, Inc.
5. Or Approved Equal

2.05 LOCKSETS

A. Locksets shall be mortised type with BEST interchangeable core 7-pin system to match existing airport keying as specified in the hardware sets.

B. Levers, escutcheons, locksets and cylinders shall be the products of one manufacturer.

C. Minimum wall thickness of levers and roses shall be .101 inch and .099 inch, respectively.

D. All latch bolts shall have 3/4 inch throw. All deadbolts shall have hardened steel inserts and 1 inch throw.

E. Products: Provide one of the following:

1. Basis of Design: Von Duprin 7500 & E-7500 Series US32D lockset and "LWA" handle design, or approved equal.

2.06 EXIT DEVICES

A. All exit devices shall be listed under "Panic Hardware" in accident equipment list of Underwriters' Laboratories (UL).

B. All labeled doors with "Fire Exit Hardware" shall have labels attached and be in strict accordance with UL requirements.

C. All exit devices shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified testing laboratory. A written certification showing successful completion of a minimum of 1,000,000 cycles shall be provided.

D. Electrified-controlled exit devices shall be UL Listed.

E. All surface strikes shall be roller type and come complete with a plate underneath to prevent movement, and shall be provided with a dead-latching feature to prevent latchbolt tampering.

F. Products: Provide one of the following:
1. Basis of Design: Von Duprin 98/99 Series, or approved equal, for mortised installation with interchangeable core, as applicable, in types and functions specified. Provide CXA-98 Series for electrified exit devices.

2.07 KEYING/KEY CONTROL SYSTEM

A. Keying: All locks shall be Master Keyed as indicated.

2.08 CLOSERS

A. Closers shall be provided in the manufacturer's recommended printed size for specified installation condition, unless otherwise noted in the Finish Hardware Schedule.

B. Closers shall be full rack and pinion complete with back check. Springs shall be motor clock type. Furnish flush mount transom brackets where no transom bar exists. Furnish parallel arm where required.

C. All closers shall be provided with limited opening resistance to meet handicap requirements.

D. Furnish drop plate brackets where required.

E. Closer at exterior doors shall be installed on the inside of the building.

F. Products: Provide one of the following:

1. “Series 1430" exterior and “Series 1431" interior closers; Sargent Manufacturing Company Div. of ESSEX Industries, Inc.*

2. “Series 8501"; Norton Door Controls Div. of Yale Security Inc.

3. An equivalent product by one of the following manufacturers:

a. LCN Closers, An Ingersoll-Rand Company.

4. Or Approved Equal

2.09 DOOR STOPS

A. Products: Provide door stop types as follows:

1. Products by H.B. Ives:*

a. Wall: “No. 407-1/2.”

b. Floor: “No. 436.”

c. Floor at Door with Threshold: “No. 438.”

2. Products by Rockwood Manufacturing Company:

a. Wall: “No. 409.”

b. Floor: “No. 441.”

c. Floor at Door with Threshold: “No. 443.”

B. Other Products: Equivalent products by one of the following manufacturers are also acceptable:

1. Glynn-Johnson, An Ingersoll-Rand Company.

2.10 SILENCERS

A. All interior metal door frames shall have door silencers, three (3) per single door, six (6) per pair of doors.

B. Products: Provide one of the following silencer types:

1. “Type 20"; H.B. Ives.*

2. “Type 64"; Glynn-Johnson, An Ingersoll-Rand Company.

3. “No. 608"; Rockwood Manufacturing Company.

4. Or Approved Equal

2.11 WEATHERSTRIPPING

A. General: Continuous weather-stripping shall be installed at each edge of every exterior door leaf.

Provide non-corrosive fasteners as recommended by manufacturer for application indicated. Include door top protection (drip caps) for exterior doors where scheduled or as required.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

C. Weather-stripping at Jambs and Heads: Bumper-type resilient insert and metal retainer strips, surface-applied. Extruded aluminum retainer, natural anodized finish; closed cell EPDM sponge neoprene insert, except vinyl insert for door shoes.

D. Products: Provide one the following products:

1. "319CR"; Pemko Manufacturing Co.*

2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:

a. Zero International, Inc.

b. Reese Enterprises, Inc.

2.12 THRESHOLDS AND DOOR BOTTOMS

A. General: Extruded aluminum units, vinyl insert, of type, size and profile as shown or scheduled. Provide thresholds at labeled doors where required by Code, whether specified or not. Product to be of one of the following manufacturers or approved equal.

B. Products, Thresholds: Provide one of the following:
1. "272A with 282A Elevator"; Pemko Manufacturing Co., Inc.*

2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:

a. Zero International, Inc.

b. Reese Enterprises, Inc.

C. Products, Door Bottoms: Provide one of the following:

1. "315CN"; Pemko Manufacturing Co., Inc.*

2. Other Products: Equivalent products by one of the following manufacturers are also acceptable:

a. Zero International, Inc.

b. Reese Enterprises, Inc.

2.13 DRIP CAPS

A. Install on all exterior doors not under cover as scheduled.

B. Products: Provide one of the following:

1. "346 AL"; Pemko Manufacturing Co., Inc.*

2. Other Products: Equivalent products by one of the following manufacturers are also

acceptable:

a. Zero International, Inc.

b. Reese Enterprises, Inc.

2.14 LATCH GUARD

A. Furnish stainless steel latch guard with flush mounted joint connector.

B. Products: Provide one of the following:

a. Rockwood Company *

b. Latch-Guard, Inc.

c. Or Approved Equal

2.15 FASTENERS

A. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flat-head screws with finished heads to match surface of door hardware.

**PART 3 - EXECUTION**

3.01 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

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

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

3.02 INSTALLATION

A. Preparation: Comply with the following:

1. Steel Doors and Frames: Comply with Door and Hardware Institute (DHI) A115 Series, “Specifications for Steel Door and Frame Preparation for Hardware (ANSI).”

B. Mount hardware units at heights indicated in the following applicable publications, except as specifically listed herein under Article 2.03 LOCATIONS, and/or otherwise directed by the Architect/Engineer and required to comply with governing regulations.

1. Steel Doors and Frames: Comply with DHI "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

C. Install each hardware item in compliance with the manufacturer's published instructions and current recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and re-installation or application of surface protection with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on the

substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3. Re-install designated hardware for doors indicated on Drawings. Repair and/or replace hardware as required to provide a complete operable, secure closure.

D. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

E. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

F. Coordinate with electrical installer for connections for power actuated hardware devices.

G. Clean adjacent surfaces soiled by hardware installation. Clean operating items as necessary to restore proper function and finish.

3.03 FINISH HARDWARE SCHEDULE

A. The following hardware set(s) are based on door location types as indicated. Refer to Drawings for specific door numbers, sizes, types, and swings.

**STEEL DOORS**
Steel Doors and Frames – Refer to Section 08 11 13 – STEEL DOORS AND FRAMES.

| **(PR) DOORS 101, 103** | | **MD x MF Swing as Indicated** |
|---|---|---|
| Hinges: | 3 pr | Hager BB1191 4-1/2 x 4-1/2 NRP US32D |
| Mortise Lockset 2 | | Von Duprin 98/99 Series Exit Device with BEST 40H Series mortise lock with BEST interchangeable 7 pin core cylinder to match with Airport Operations and surface mounted vertical cable/rod device combination – same direction US32D (F05 Classroom) |
| Closer: | 2 | LCN 4050 Series PA Full Cover SBL |
| Latch Guard | 1 | Rockwood 320-RKW |
| Kick Plate | 2 | Rockwood K1050 (US32D 8”x46”) |
| Threshold | 1 | Pemko 272A AL |
| Door Bottom | 2 | Pemko 315CN AL |
| Weatherstripping | 1 Set | Pemko 319CR AL |
| Drip Cap | 1 | Pemko 346 AL |

| **DOOR 102, 102A** | | **MD x MF Swing as Indicated** |
|---|---|---|
| Hinges: | 1-1/2 pr | Hager BB1191 4-1/2 x 4-1/2 US32D |
| Mortise Lockset: | 1 | Von Duprin 7500 Series US32D – BEST 40 H Series mortise lock with BEST interchangeable 7 pin (F05 Classroom) Removable Core Cylinder (Coordinate matching cores with Airport Operations) |
| Closer: | 1 | LCN 4050 Series PA Full Cover SBL |

| | | |
|---|---|---|
| Door Stop: | 1 | Ives 407-1/2 (Door 102A only) |
| Kick Plate | 1 | Rockwood K1050 (US32D 8”x34”) |

**END OF SECTION 08 71 00**

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# SECTION 08 91 19 - FIXED LOUVERS

## PART 1 - GENERAL

1.01 SUMMARY

A. This section includes:

1. Fixed extruded aluminum wind driven rain resistant louvers and related attachments/accessories as indicated on Drawings and specified herein.

B. Related Section include the following:

1. Division 6 Section “Rough Carpentry” for pressure treated wood nailers, blocking, and sheathing required for roofing work.

2. Division 7 Section “Flashing and Sheet Metal” for sheet metal flashing, coping, and sheet metal closures for roofing work.

3. Division 7 Section “Joint Sealants” for sealing joints.

4. Division 4 Section “Masonry Units”.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations: Obtain stationary blade louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

### 2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade shall pass basic protection, large-missile testing requirements in ASTM E 1996 for designated wind zone when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than louvers indicated for use on Project.

1. Component Importance Factor: 1.0.

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Design: Extruded aluminum, stationary louvers with horizontally mounted drainable blades.

1. Basis-of-Design Product: Ruskin Company or approved equal product by one of the following:

a. Air Flow Company, Inc.
b. Airolite Company, LLC (The).
c. Greenheck Fan Corporation.
d. Reliable Products, Inc.

2. Louver Depth 6 inches
3. Blade Profile: Drainable-blade louver with blade gutters (drains) in rear two-thirds of blades only and with semi recessed mullions capable of collecting and draining water from blades.

4. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and for frames.

### 2.4 LOUVER SCREENS

A. General: Provide screen at all louvers.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless-steel machine screws spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

## 2.5 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type as recommended by manufacturer.

G. Provide sill flashing for all louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view or as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. The supporting structure shall be designed to accommodate the point loads transferred by the louvers when subject to the design wind loads.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

**END OF SECTION 08 91 19**

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# TECHNICAL SPECIFICATIONS

# DIVISION 09
# FINISHES

# SECTION 09 22 00 - PORTLAND CEMENT STUCCO

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes:

1. Portland cement stucco and related accessories.

B. Related Sections include the following:

1. Division 4 Section “Unit Masonry” for masonry work.

2. Division 9 Section “Painting” for painting stucco.

1.02 DESIGN CRITERIA

A. Allowable Tolerances: For flat surfaces, do not exceed 1/4-inch in 8 feet for bow or warp of surface, and for plumb and/or level.

1.03 QUALITY ASSURANCE

A. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified:

1. American Society for Testing and Materials (ASTM):

a. Referenced Standards.

2. Portland Cement Association (PCA):

a. PCA "Plasterer's Manual."

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product specifications and installation instructions for each product, including data showing compliance with specification requirements.

B. Samples: Submit three (3) samples on cement board backing indicative of proposed finish. Approved samples shall become the basis of comparison for all stucco work.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All manufactured materials shall be delivered in the original packages, containers, or cartons, bearing the brand name and manufacturer's identification, and stored in a dry space, protected from the elements and from damage to containers.

1.06 PROJECT CONDITIONS

A. Protection of Surfaces:
1. Use all means necessary to protect the stucco work and materials of this Section before, during and after installation; and to protect the work and materials of other trades from moisture deterioration and soiling that may occur from stucco operations.

2. Provide temporary covering or other provisions as may be necessary to minimize harmful spattering of stucco on other work.

3. Do not apply stucco immediately before or during a rainstorm.

B. Environmental Conditions:

1. Warm Weather Requirements: Protect stucco against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial.

2. Cold Weather Requirements: Enclosures shall be provided in cold weather to allow uniform temperature range of 50 degrees F to 70 degrees F to be maintained.

## PART 2 - PRODUCTS

2.01 STUCCO MATERIALS

A. General: Except as otherwise indicated, provide standard products recommended by the manufacturer for the application indicated, complying with ASTM C926.

B. Portland Cement: Provide portland cement complying with ASTM C150, Type I; and from one source to ensure uniformity in the work. Approved types of plasticity agents may be added to portland cement in the manufacturing process or when mixing; however, in no case shall the amount of plasticity agent exceed 10 percent of the volume of cement in the stucco mix.

C. Lime: Provide dry hydrated lime, complying with ASTM C206, Type S.

D. Aggregates: Provide aggregates complying with ASTM C897.

E. Water: Provide clean water, free from injurious amounts of oils, acids, alkalies, salts, organic materials, or substances that may be deleterious to the stucco or metal accessories.

F. Integral Waterproofer: Provide manufactured product that is a composed of stearate water repellents and other chemicals which, when used as an admixture, form an internal barrier against water penetration. The admixture shall increase the plasticity of the stucco, reduce water absorption and guard against freeze-thaw damage. Admixture can be supplied in either a powdered form without chlorides or in a liquid formula which contain chlorides for additional densification and acceleration of the stucco. Admixture shall not increase the air content of stucco.

G. Bonding Agents (If Indicated or Required): Bonding agents, integral or surface-applied, shall be used in accordance with the manufacturer's published instructions.

H. Steel Framing: Steel framing shall be as shown and shall be manufacturers standard products with shop applied protective coating.

I. Plywood: Plywood shall be mechanically attached through insulation to CMU structural wall.

J. Felt: Thirty (30) pound asphalt felt shall be installed with corrosion resistant fasteners according to manufacturers requirements in two overlapping layers to plywood on all wall surfaces.

K. Metal Lath

1. Metal lath shall conform to ASTM C847, types and weights in accordance with the various spacing shown in ASTM C841.

2. Lath for application on steel and wood framing supports shall be expanded metal or welded or woven wire and shall have paper backing with a minimum vapor permeance of 5 perms. Expanded metal lath shall be fabricated in a manner to provide not less than 1/4 inch keying between wire and paper backing and keying shall be obtained by a uniform series of slots in a perforated face paper woven between the wires.

L. Plastic Accessories: Manufactured from high-impact PVC.

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

a. Alabama Metal Industries Company; a Gibraltar Industries company.
b. Phillips Manufacturing Co.
c. Plastic Components, Inc.

2. Cornerbeads: With perforated flanges. Small nose cornerbead; use unless otherwise indicated.

3. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated. Bullnose style, radius 3/4-inch minimum; use at locations indicated on Drawings.

4. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

5. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch wide reveal; with perforated concealed flanges.

## 2.02 MIXING AND PROPORTIONING STUCCO

A. All stucco mix ingredients shall be mixed in a mechanical mixer with the minimum amount of water needed to produce stucco of workable consistency. Stucco shall be mixed for a minimum of 2 minutes or until all ingredients are uniform in color after all ingredients are in the mixer.

B. Stucco ingredients shall be mixed in the following proportions:

1. Three (3) Coat Application:

| Coat | Portland Cement | Lime by Volume | Aggregates by Volume | Integral Waterproofer |
|---|---|---|---|---|
| 1st (base) | 1 | - - - | 3-1/2 | - - - |
| 2nd (brown) | 1 | 15% max. | 2 | 1 qt. per bag of cement |
| 3rd (finish) | 1 | 15% max. | 2 | 1 qt. per bag of cement |

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which this Work is to be performed. Correct conditions detrimental to the proper and timely completion of this Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prior to application, ensure mechanical and electrical services behind surfaces to receive stucco have been tested and approved.

B. Place metal accessories true to lines and levels, neatly butted at joints and intersections. Use longest pieces available; multiple short sections are not acceptable.

3.03 STUCCO APPLICATION

A. General:

1. Stucco application shall be performed by skilled mechanics experienced in this type of work. All work shall be properly rodded true and straight, flush with grounds applied in strict accordance with ASTM C 926 and with the recommendations of the PCA "Plasterer's Manual," unless otherwise indicated.

2. Do not use materials which are caked or lumpy, or which are dirty or contaminated by foreign materials. Use only clean water, free from impurities that might impair the work; do not use water that has been used to clean tools. Do not use excessive water in the mixing and application of stucco materials.

3. Sequence stucco applications with other work in accordance with recognized industry standards. Delay application of finish coat until adjoining work has been completed, wherever possible.

4. Screed stucco work at all angles, arises, corners, and every 8 feet on surfaces. Place screeds to true grounds; scrape screeds and grounds clean. All finished surfaces shall be straight, true, and plumb. Form corners, angles, and intersections accurately, in perfect line, every angle true and full.

B. Thickness:

1. Stucco shall be applied in thicknesses as follows:

| Stucco Base | First (Base) Coat | Second (Brown) Coat | Third (Finish) Coat | Total Thickness |
|---|---|---|---|---|
| Masonry | 3/8" | 3/8" | 1/8" | 7/8" |

C. Methods:

1. First (Base) Coat: Apply first (base) coat to masonry with sufficient pressure to form a good key. Bring to plumb, true, even surface, rough in texture. When sufficiently set, float scratch with dry float. Cross scratch evenly to form bond for second (brown) coat.

2. Second (Brown) Coat: Apply second (brown) coat as soon as first (base) coat has set sufficiently to carry the weight (approximately 3 hours). Float or rod to true, even surface and keep moist until application of third (finish) coat.
3. Third (Finish) Coat: Apply third (finish) coat as soon as possible after brown coat hardens; usually the next morning. Use float for preliminary finishing then steel trowel for final compacting. Finish shall be as selected and approved by the Owner and/or Architect/Engineer.

    a. Finish coat to be painted as specified under Section 09 91 00 “Painting.”

D. Curing: Damp cure stucco as follows:

1. Surfaces shall be protected from the sun, hot-dry winds, or excessive ventilation using canvas, cloth, or plywood barriers; then kept moist with a fog spray of water until proper hydration takes place; usually 48 hours for temperatures ranging 50 degrees F and above. Alligatoring and multiple shrinkage cracks will be cause for replacement of material.

2. Do not damage finished surface by water erosion during damp curing operation.

3.04 LATH

A. Install lath in accordance with ASTM C841 or ASTM C1063 except as otherwise specified. Metal lath shall be applied straight, without buckles and with joints staggered. End laps of metal lath shall be not less than 1 inch. When paper-backed lath is used, the paper shall be split from the lath at all lap areas to provide a paper to paper and lath to lath lap. Horizontal joints shall be shiplapped. Lath shall be interrupted at all control joints. Submit drawings showing details of construction for reinforcement, furring, and grounds; including manufacturer's installation instructions for stucco materials, and locations where each mix and oating thickness will be used.

3.05 INSTALLING ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners: Install cornerbead at exterior locations.

C. Control Joints: Locate as approved by Architect/Engineer for visual effect and as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

    a. Vertical Surfaces: 144 sq. ft.

    b. Horizontal and Other Non-vertical Surfaces: 100 sq. ft.

2. At distances between control joints of not greater than 18 feet o.c.

3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.

4. Where control joints occur in surface of construction directly behind plaster.

5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.06 CUTTING AND PATCHING

A. Cut, patch, repair and point-up stucco as required and as necessary to accommodate other work. Repair cracks and indented surfaces. Point-up finish stucco surfaces around items that are built into or penetrate stucco surfaces. Repair or replace stucco work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar imperfections. Repair or replace the work as necessary to comply with specified tolerances and required visual effects.

3.07 PROTECTION

A. Remove temporary covering and other provisions made to minimize splattering of stucco on other work. Repair surfaces that have been stained, marred or otherwise damaged during stucco work.

## END OF SECTION 09 22 00

# SECTION 09 91 00 - PAINTING

## PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes:

1. Surface preparation and application of painting and related work in locations indicated on the Drawings and specified herein.

B. Related Sections include the following:

1. Division 5 Section “Metal Fabrications” for coating of fabricated metal items.

2. Division 8 Section “Steel Doors and Frames” for coating steel doors and steel frames.

4. Division 9 Section “Cement stucco” for painting stucco.

1.02 QUALITY ASSURANCE

A. All surfaces of fabricated items that are left unfinished by the requirements of other sections shall be painted under this Section. All work specified in this Section shall be in addition to shop and mill coats, priming and field coats which are specified in other sections.

B. Perform all touching up of shop coats and field coats of paint on structural steel and miscellaneous steel or iron as required and/or specified.

C. Aluminum, steel, stainless steel, copper, bronze, chromium plating, nickel, monel metal, lead, lead coated copper and other surfaces with factory finishes shall not be painted or finished, except as otherwise specified.

D. Remove and re-finish or otherwise correct in a manner approved by Architect/Engineer all work under this Section which peels, crazes, blisters, fails to adhere or otherwise fails to properly serve its intended purpose at no additional cost to the Owner.

1.03 PRODUCT DELIVERY AND STORAGE

A. All materials shall be delivered to the Site in manufacturers' sealed packages, with labels intact.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer(s) product data for each type of product used.

B. Samples: Submit three (3) sets of full color chip line for each type of paint specified, for color selection(s) by the Architect/Engineer.

C. Draw Downs: Provide three (3) stepped draw downs, defining each separate coat, including block fillers and primers, for each color and material to be applied. Use representative colors when preparing draw down for review.

## PART 2 - PRODUCTS

2.01 MATERIALS

A. Conform to the coating specifications and standards referenced herein under PART 3.09 – PAINTING SCHEDULE.

B. MPI System numbering system herein specified is found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an EXTERIOR or INTERIOR system.

C. All ready-mixed paints shall be first-line (best quality grade) retail products. The use of lead-containing paint is NOT permitted.

D. Thinners and additives shall be of types recommended by the paint manufacturer.

## PART 3 - EXECUTION

3.01 INSPECTION

A. Examine the areas and conditions under which painting is to be applied. Do not proceed with painting work until unsatisfactory conditions have been corrected.

3.02 COLORS

A. The Architect/Engineer will select all colors and provide a schedule of colors and finishes.

B. Each coat of paint shall be applied in varying shades, with the final coat matching the approved color selected.

3.03 PREPARATION FOR PAINTING

A. Surfaces to be painted shall be clean, smooth, free from scratches and dust and thoroughly dry. Wood surfaces shall be well sanded before painting work is started.

B. Concrete surfaces shall be cleaned, grouted, rubbed and pointed, water flushed clean and free of all dust, oily grease and laitance, and allowed to dry prior to painting.

C. Steel and iron shall be free from grease, rust, scale and dust. Touch up any chipped or abraded places on items that have been shop coated. Where steel and iron have heavy coating of scale, it shall be removed by wire brush or sand blasting necessary to produce a satisfactory surface for painting.

3.04 PROTECTION

A. Adjacent fixtures and hardware shall be removed during the painting application.

B. Particular care shall be taken by the use of clean drop cloths, masking and other suitable means, to protect adjoining surfaces, fixtures, and materials of all kinds. Painting applicator shall be held responsible for, and shall repair, all damages resulting from the painting operation.

C. All ceiling and soffit overhead painting shall be applied only while the floor is completely and continuously covered with drop cloths.

3.05 APPLICATION

A. Paints shall be applied in the colors and minimum number of coats scheduled herein and at the square foot coverage as stated in the paint manufacturer's printed specifications. It is intended that paint so applied shall cover to the satisfaction of the Architect/Engineer or additional coats shall be applied until approval is obtained.

B. Paints shall not be applied to surfaces which show a moisture content greater than 15 percent as determined by an electronic moisture meter.

C. Paints shall not be applied when the temperature falls below 45 degrees F., in damp, rainy weather, or when the relative humidity exceeds 85 percent.

D. Paint shall be evenly spread and well distributed. The finish coats shall be free from any noticeable laps, brush marks, streaks, runs, sags, wrinkles, and shiners.

E. All wood surfaces shall be thoroughly sanded between coats as required for a flaw-free finish.

3.06 BACK PRIMING

A. All wood surfaces (except pressure treated wood) to be placed against concrete or masonry substrates shall be painted with a sealer coat of paint or clear varnish before installation

3.07 TOUCH UP AND CLEANING

A. Upon completion, all touching-up as required shall be applied and any paint shall be removed from all surfaces which are not specified to receive paint.

3.08 PAINTING OF PIPING FOR IDENTIFICATION

A. Exposed piping, piping concealed in accessible pipe spaces and piping behind access panels shall be identified to designate service.

B. Legend shall be stencil applied (painted on) at 40 feet spacing on straight runs where pipes pass through walls or floors and regulators, strainers, and clean-outs (except valves and fittings on plumbing fixtures and equipment).

C. Legend shall give name in full or abbreviations. Size of stenciled identity lettering shall vary with the diameter of pipe covering as follows:

1. Up to 1": 1/2" high letters.

2. Over 1": 3/4" high letters.

3.09 PAINTING SCHEDULE

A. The following surfaces shall be finished with the designated number of coats (in addition to shop or manufacturer's coats) with a Dry Film Thickness (DFT) of not less than indicated:

B. Omit primer on items with shop coat primer. All shop coats shall be touched up with the same kind of paint as the shop coat and allowed to dry before application of finish coats.

**EXTERIOR**

1. Metal, Galvanized: MPI EXT 5.3J-G5 – Waterborne Light Industrial - Semi-Gloss Finish.

a. Primer: MPI 134
b. Intermediate: MPI 163
c. Topcoat: MPI 163
d. System DFT: 4.5 mils.

2. Metal, Ferrous: MPI EXT 5.1Q-G5 – Alkyd - Semi-Gloss Finish.

a. Primer: MPI 23
b. Intermediate: MPI 94
c. Topcoat: MPI 94
d. System DFT: 5.25 mils.

3. Concrete: MPI EXT 3.1A – Latex - Semi-Gloss Finish.

a. Primer: MPI 4
b. Intermediate: MPI 11
c. Topcoat: MPI 11
d. System DFT: 3.5 mils.

4. Portland Cement Plaster (Stucco): MPI EXT 3.1A – Latex - Semi-Gloss Finish.

a. Primer: MPI 4
b. Intermediate: MPI 11
c. Topcoat: MPI 11
d. System DFT: 3.5 mils.

**INTERIOR**

1. Metal, Galvanized: MPI INT 5.3J-G5 – Waterborne Latex - Semi-Gloss Finish.

a. Primer: MPI 134
b. Intermediate: MPI 43
c. Topcoat: MPI 43
d. System DFT: 4.5 mils.

2. Metal, Ferrous: MPI INT 5.1E-G5 – Alkyd - Semi-Gloss Finish.

a. Primer: MPI 79
b. Intermediate: MPI 47
c. Topcoat: MPI 47
d. System DFT: 5.25 mils.

3. Piping and Conduit~~,~~ Exposed Surfaces: Semi-Gloss Finish.

a. Ferrous Metal: MPI INT 5.4F-G3 – Alkyd.

(1) Primer: MPI 79
(2) Intermediate: MPI 47
(3) Topcoat: MPI 47
(4) System DFT 4.4 mils

b. Aluminum and Galvanized Metal: MPI INT 5.4F-G3 - High Performance Architectural Latex.

(1) Primer: MPI 95
(2) Intermediate: MPI 139

(3) Topcoat: MPI 139
(4) System DFT: 5 mils

4. Masonry and Concrete: MPI INT 4.2D-G3 - High Performance Architectural Latex - Eggshell Finish

a. Filler: MPI 4
b. Primer: N/A
c. Intermediate: MPI 139
d. Topcoat: MPI 139
e. System DFT: 11 mils

**END OF SECTION 09 91 00**

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# TECHNICAL SPECIFICATIONS

# DIVISION 23
# MECHANICAL

# SECTION 23 05 00 - GENERAL HVAC REQUIREMENTS

## PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies general mechanical requirements for Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) Specification Sections.

B. Drawings and Specifications: The Drawings and Specifications shall be considered as complementary, one to the other, so that materials and work indicated, called for, or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. The Drawings are to be considered diagrammatic, not necessarily showing in detail or to scale all of the equipment or minor items. In the event of discrepancies between the Drawings and the Specifications, or between either of these and any regulations or ordinances governing mechanical work, notify the Engineer in ample time to permit revisions.

1.02 RELATED WORK

A. GUARANTEES/WARRANTIES/REPAIRS: CONTRACT GENERAL PROVISIONS.

B. RECORD DOCUMENTS, MAINTENANCE MANUALS, AND EQUIPMENT OPERATIONAL INSTRUCTIONS/DEMONSTRATIONS: CONTRACT GENERAL PROVISIONS.

C. PAINTING: Section 09 91 00.

D. TEST AND BALANCE: Section 23 05 93.

F. DIVISION 26 - ELECTRICAL Sections.

1.03 CODES AND STANDARDS

A. The codes and standards covering mechanical work include, but are not limited to:

1. American National Standards Institute (ANSI).

2. American Society for Testing and Materials (ASTM).

3. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

4. American Society of Mechanical Engineers (ASME).

5. American Welding Society (AWS).

6. Florida Building Code, Latest Adopted Editions, complete, as amended.

7. Florida Department of Environmental Protection (DEP) Regulations.

8. National Electrical Manufacturers Associations (NEMA).

9. National Fire Protection Association (NFPA).

a. NFPA 30 Flammable and Combustible Liquids Code.

b. NFPA 58 Storage and Handling of Liquefied Petroleum.

c. NFPA 90A Installation of Air Conditioning and Ventilating Systems.

d. NFPA 90B Installation of Warm Air heating and Air Conditioning Systems.

e. NFPA 101 Life Safety Code.

10. National Sanitation Foundation (NSF).

11. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

12. Codes, Regulations, Ordinances, and similar regulatory requirements, of all governing authorities having jurisdiction over this Work.

B. These codes, society and association recommendations constitute minimum requirements and no reductions from design requirements will be permitted, even if allowed by the applicable codes, without expressed written permission of the Engineer.

1.04 SHOP AND ERECTION DRAWINGS

A. Submit required and requested shop and erection drawings for review by Engineer before ordering or installing any equipment or material. Equipment or material ordered or installed before Engineer's review may not be accepted and will have to be removed from the Project.

B. Shop drawings shall consist of manufacturer's scale drawings, cuts or catalogs, including descriptive literature which shall clearly indicate the construction, material, physical dimensions, wiring diagrams and complete operating data clearly marked for each item. Data of general nature will not be accepted.

C. Erection drawings shall consist of 1/4" scale drawings of the work including foundations in plan and elevation. These drawings shall show clearances between units and relation of equipment to space assigned and to the work of other trades. Normally, with the exception of drawings for ductwork, erection drawings are required for mechanical equipment rooms. Provide drawings for other area requested by the Engineer.

D. Prior to making any changes in the Work that is shown on the Contract Drawings, prepare and submit to the Engineer a drawing with a minimum of 1/4" scale showing proposed change. Do not proceed with the change without a written approval by the Engineer. All such approved drawings shall be included into final set of record drawings.

E. The Engineer's approval of shop drawings does not relieve the Contractor of their responsibility to comply with all requirements of this Specification.

1.05 RECORD DRAWINGS

A. Record Drawings shall be submitted to the Engineer before Final Acceptance and shall include the following as a minimum requirement:

1. Utility surveys indicating the underground work performed under this Section and giving dimensions from fixed reference points.

2. Equipment schedules shall reflect all changes in the approved equipment that deviate from the schedules and shall include the Manufacturer's name, model number, performance capacities and accessories.

B. Refer to CONTRACT GENERAL PROVISIONS For additional requirements.

1.06 FEES, PERMITS AND INSPECTIONS

A. Obtain all permits for work under this Contract and pay all expenses in conjunction therewith. Also, procure and deliver to the Engineer all certificates issued by the authorities having jurisdiction.

B. The work will be observed by the Engineer during the course of construction. Provide for inspection by others having jurisdiction during the proper phases.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site at such intervals to ensure uninterrupted progress of work.

B. Deliver anchor bolts, anchorage devices, and sleeves which are to be embedded in cast-in-place concrete or masonry, in ample time not to delay work.

C. Store materials to permit easy access for inspection and identification. Keep steel members off ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

D. Do not store materials on structure in a manner that might cause distortion or damage to members or support structures. Repair or replace damaged materials or structures as directed at no additional cost to the Owner.

**PART 2 - PRODUCTS**

2.01 GENERAL

A. Materials or products specified herein and/or indicated on Drawings by trade name, manufacturer's name and/or catalog number shall be provided as specified.

B. Since manufacturers reserve the right to change their products at anytime, verify all dimensions, performance data, and similar criteria for each piece of equipment submitted to ensure compliance with the intent of the Drawings and Specifications.

C. All materials shall be new of the quality specified.

D. Deviations mean the use of any listed approved manufacturer other than those on which the Drawings are based.

2.02 SPACE AND ACCESS TO EQUIPMENT

A. All equipment shall fit the allotted space and shall leave reasonable access room for servicing and repairs. Greater space and room required by substituted equipment shall be provided by the Contractor at no additional cost to the Owner.

B. Provide access panels to service and maintenance devices such as cleanouts, air vents, service valves, air volume balancing dampers, fire dampers, and similar items that are installed in concealed spaces.

2.03 CUTTING AND PATCHING

A. Unless otherwise indicated on the Mechanical Drawings, perform all cutting and patching necessary for the Work. Where interferences occur, and departures from indicated arrangements are required, coordinate the mechanical work with the other trades involved and make a determination as to changed locations and elevations of the ductwork and/or piping and shall obtain approval from the Engineer for the proposed changes.

2.04 SAFETY REQUIREMENTS

A. In addition to the components specified and shown on the Drawings and necessary for the specified performance, incorporate in the design and show on the shop drawings all the safety features required by the current codes and regulations, including but not limited to those of the Occupational Safety and Health Act of 1970, and Amendments thereto.

2.05 ELECTRICAL WORK

A. Furnish all control wiring and conduit for the HVAC equipment and include control devices such as thermostats, control switches, contactors, relays and starters. All Work shall conform in all respects to the requirements of the applicable requirements of Division 26 Specifications.

2.06 CLEANING AND PROTECTING

A. During construction protect all piping and equipment from damage and dirt. Cap the open ends of all piping and equipment.

B. After completion of Project, clean the exterior surface of equipment included in this Section, remove all residues and as directed touch up paint or completely repaint all damaged surfaces.

2.07 PAINTING

A. All field painting unless otherwise noted shall be as specified in Section 09 91 00 - PAINTING.

B. All equipment shall have factory standard finish, except as specifically indicated herein. Where zinc chromate paint is specified it shall be formulated using a synthetic resin vehicle.

C. Ironwork installed under this Division of the Specifications exposed to view within the building, and not otherwise specified to be painted, galvanized, copper or chrome plated, such as piping, pipe hangers, structural supports, supports for apparatus, black iron partitions or casings, tanks, and similar items shall be painted with one coat of zinc chromate primer.

2.08 EQUIPMENT IDENTIFICATION

A. Identify each unit by its system number and other appropriate designation by engraved plastic nameplates in letters of approved size and wording. Equipment requiring identification shall include packaged and split system air conditioning units and heating unit.

2.09 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Engineer before work is performed.

B. Provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight. Waterproof flashing materials shall be compatible with base materials.

## PART 3 - EXECUTION

3.01 PREVENTION OF ELECTROLYSIS

A. Where the contact of dissimilar metals may cause electrolysis and where copper will contact concrete, mortar or plaster, separate metal contact surfaces with not less than one coat of zinc chromate primer and one heavy coat of aluminum pigmented asphalt paint on each surface; or where deemed necessary by the Engineer, not less than open course of asphalt saturated cotton fabric cemented to both metals with flashing cement, shall be used. Completed work shall be cleaned and excess cement removed.

3.02 TESTS AND INSPECTIONS

A. Provide equipment start-up procedures in accordance with manufacturer's recommended guidelines and installation checklist. Provide factory certifications where required for warranty purposes.

B. Include all tests and inspections specified and/or required under laws, rules and regulations of all departments having jurisdiction. Tests shall be performed as indicated herein and other Sections of Specifications.

C. Refer to TSP Section 23 05 93 – TEST AND BALANCE, for additional HVAC test and inspection procedures.

D. Notify the Engineer at least 72 hours in advance of all tests. Furnish all necessary instruments, gauges and other equipment required for tests. Make preliminary tests prior to giving notice of final tests.

E. All parts of the work and associated equipment shall be tested and adjusted to work properly and be left in perfect operating condition.

F. Correct defects disclosed by these tests without any additional cost to the Owner. Repeat tests on repaired or replaced work.

G. Maintain separate log of all tests being conducted and have it available for review by Engineer. Log to indicate date, type of tests, duration and defects noted and when corrected.

H. The Building Inspection/Permitting Agency shall perform acceptance and inspection of mechanical and plumbing systems.

3.03 ACCEPTANCE INSPECTION

A. Representatives of installers responsible for work under this Division shall be present at time of acceptance inspections and shall furnish required mechanics, tools, and ladders to assist in the inspection.

B. As a precedent to requesting a final inspection, the following steps shall be met:

1. Complete all work under this Section of the Specifications.

2. Have each system balanced to assure design performance. (See Section 23 05 93 - TEST AND BALANCE for detailed requirements.)

3. Furnish the Engineer with letter from an authorized representative of the equipment manufacturer certifying that all work has been checked for operation and calibration and that the system is operating as intended.

4. Clean all dirty cooling coils and other equipment that may have accumulated dirt during construction.

C. A list of items to be corrected as a result of acceptance inspection will be furnished to the installer. Notify Engineer in writing of any items appearing on list of correction that are disputed by installer. When ready, request in writing a re-inspection of Work.

D. Provide certification that all work is in conformance with all codes and standards by the governing agencies having jurisdiction of the work.

E. Provide hard copy of HVAC equipment parts manual to Construction and Engineering Inspection (CEI) prior to Final Acceptance of the building by Owner. Provide one (1) complete hard copy to remain in each building for future use.

3.04 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Bound Instructions: Before final payment is made, furnish 6 sets of bound operation and maintenance manuals to the Owner. The manuals shall consist of catalog cuts, bulletins, shop drawings, wiring diagrams, schedules, parts lists, procedures and other data showing the equipment installed and shall include the following:

1. Approved wiring and control diagrams, with data to explain the detailed operation and control of each component.

2. A control sequence describing startup, operation and shutdown.

3. Operating and maintenance instructions for each piece of equipment, including lubrication instructions.

4. Parts lists and recommended spare parts.

5. Other data and instructions as specified under the various Sections.

B. All data furnished shall conform to the installation as constructed. Cuts showing other equipment and data not applicable to the installation shall be crossed out and where practical shall be omitted from the manual. The assembly of the manual shall be in a logical manner and each section shall be indexed in the Table of Contents.

C. After each manufacturer has outlined a maintenance procedure for that manufacturer’s equipment installed, compile these procedures in a logical manner to provide a procedure for the operating personnel of the Owner to follow in their day to day operation of the facility.

D. The materials shall be permanently bound into each booklet between rigid plastic or cloth binding covers. The instruction booklets shall be approximately 9-inches by 12-inches and the diagram booklet large enough to contain the drawing without excessive folding so that they may be easily opened.

E. The booklets shall be neatly entitled with a descriptive title, the name of the job, the location, year of installation, Owner, Manufacturer, Contractor and Engineer. Copies of drawings shall be in black and white background and shall be easily legible. The arrangements of the booklets, the method of binding, materials to be included and the composite text shall all be reviewed and approved by the Engineer.

3.05 OPERATIONS INSTRUCTION TO OWNER

A. Provide a minimum of 1 hour of instruction to representatives of Owner in operation and maintenance of all installed mechanical systems and equipment.

B. Provide maintenance manual and acquaint Owner's representative with its contents during instruction.

C. Furnish letter naming Owner's personnel receiving instruction and dates when instruction was given.

D. Provide name, address and telephone number of the manufacturer's representative and Service Company, for each piece of equipment so that service or spare parts can be readily obtained.

**END OF SECTION 23 05 00**

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# SECTION 23 05 93 - TEST AND BALANCE

## PART 1 - GENERAL

1.01 SUMMARY

A. Procure the services of an independent Test and Balance Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems.

B. Agency to balance, adjust, and test following systems and/or equipment:

1. Air distribution systems including air handling units and air devices.

C. As soon as possible after receipt of this Contract, allow the Test and Balance Agency to schedule it's work in cooperation with other trades involved and comply with the completion date(s) or calendar days required for completion, as specified.

1.02 RELATED WORK

A. GENERAL HVAC REQUIREMENTS: Section 23 05 00.

B. PACKAGED AIR CONDITIONERS: Section 23 81 00.

1.03 QUALITY ASSURANCE

A. The Test and Balance Agency shall submit proof of having successfully completed at least five (5) projects of similar size and scope, and shall be certified as conforming to the standards and guidelines of the Associated Air Balance Council (AABC), unless otherwise approved.

B. All instruments used shall be accurately calibrated within six months of balancing and maintained in good working order. If requested, the test shall be conducted in the presence of the Engineer and/or his representative.

1.04 SUBMITTALS

A. Complete report of the test and balance data.

B. Test and Balance Agency qualifications.

C. Warranty.

1.05 AIR BALANCE SCOPE

A. The Test and Balance Agency shall perform the following tests of and balance the air handling systems in accordance with the following requirements:

1. Test and adjust RPM to original requirements.

2. Test and record motor full load amperes.

3. Test and adjust system for original design CFM recirculated air.

4. Test and record entering air temperatures. (D.B. cooling)

5. Test and record entering air temperatures. (W.B. cooling)

6. Test and record leaving air temperatures. (D.B. cooling)

7. Test and record leaving air temperatures. (W.B. cooling)

8. Adjust main supply air ducts to proper design CFM.

9. Test and Balance Agency shall check all controls for proper calibrations and list all controls requiring adjustments by Contractor.

1.06 TEST BALANCE REQUIREMENTS

A. All information required as shown but not listed to shall be compiled in a neat, orderly itemized format on AABC Test Forms. All test data shall be submitted to the Engineer.

1.07 EVAPORATOR COIL

A. Mark Number.

B. Total Supply Air CFM original Specified and Actual.

C. Return Air CFM original Specified and Actual.

D. Cooling - Return and Supply Air DBF and WBF originally Specified and Actual.

E. Motor HP originally Specified and Actual.

F. Motor and Fan RPM originally Specified and Actual.

G. Voltage, Phase and Cycles originally Specified and Actual.

1.08 AIR DEVICES (GRILLES, REGISTERS AND DIFFUSERS)

A. Mark Number.

B. Room Number.

C. CFM Specified and Actual.

D. Size.

E. Effective Area.

F. Velocity FPM.

## PART 2 - PRODUCTS

"Not Used"

## PART 3 - EXECUTION

3.01 GENERAL

A. Air balance and testing shall not begin until modifications to the system have been completed and the system is in full working order. Mechanical systems installer shall make all preliminary tests and adjustments, shall place all systems and equipment into full operation and continue the operation during each working day of testing and balancing.

B. All testing shall be performed with the building empty of workers and the door closed at all times.

C. Testing shall begin only after the building temperature and conditions have stabilized in order to obtain accuracy of the report findings.

D. Replacement of adjustable pulleys, additional balancing dampers, pressure taps, balancing valves, cocks, fittings, and similar items required to effect proper air balance shall be furnished and installed by the mechanical HVAC installer at no additional cost to the Owner.

E. Test and Balance Agency shall furnish the Contractor and Engineer at the end of each day a list of items that must be repaired or adjusted.

F. This work shall be performed as soon as possible so as not to delay the completion of the test and balance work.

G. Submit complete report of the test and balance data of air conditioning, heating, and ventilating systems for review by the Engineer and Engineer of Record.

H. All air filters and strainers shall be cleaned or replaced by the mechanical HVAC Installer before the test and balance work can proceed and thereafter as required by the Test and Balance Agency.

I. Test and Balance Agency personnel shall be responsible for the drilling of test holes into ductwork and shall install suitable insert plug into each hole at the conclusion of each test.

J. Lock in place all volume damper handles after final adjustments are made and permanently mark the set point of adjustment.

## END OF SECTION 23 05 93

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# SECTION 23 11 13 - FUEL OIL PIPING

## PART 1 - GENERAL

1.01 SUMMARY

A. Furnish and install the fuel oil supply and return piping system between the steel aboveground fuel storage tank and the stand-by generator including valves, fittings, accessories, pipe supports and covers.

B. The head loss (pressure drop) associated with the supply and return piping shall not exceed the capabilities of the engine generator fuel pump.

C. The exposed fuel oil piping shall be protected by a corrosion resistant 10 gauge aluminum diamond plate shield that is bolted to the concrete pad. The pipe shield will protect the pipes from physical damage and also prevent excessive heating by the sun.

1.02 RELATED WORK

A. GENERAL HVAC REQUIREMENTS: Section 23 05 00.

B. ABOVE GROUND FUEL STORAGE TANK: Section 23 13 23.

C. ENGINE GENERATOR: Section 26 32 13.

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI):

1. Referenced Standards.

B. American Society of Mechanical Engineers (ASME):

1. Referenced Standards.

C. American Society for Testing and Materials (ASTM):

1. Referenced Standards.

D. National Fire Protection Agency (NFPA):

1. NFPA 30 Flammable and Combustible Liquids Code.

E. State of Florida Department of Environmental Protection (DEP):

1. DEP 62-762 Aboveground Storage Tank Systems.

F. American Petroleum Institute (API):

1. API 607 Fire Test of Quarter Turn Valves and Valves Equipped with Non-Metallic Seats.

1.04 SUBMITTALS

A. Shop drawings for all piping, fittings, valves and pipe supports shall be provided including all certifications as required.

B. Submit head loss calculations showing that the pressure drop through the fuel oil piping, valves, elbows, anti-siphon valve etc., does not exceed the capability of the engine generator fuel pump.

C. Provide all submittal requirements of TSP Sections 23 11 13 FUEL OIL PIPING and 23 13 23 ABOVEGROUND DIESEL FUEL STORAGE TANK AND PIPING as one submittal package for review.

1.05 QUALITY ASSURANCE

A. Qualifications of Welders: All welders employed for this Work shall be qualified under the requirements of ANSI B31.1.0 Section 127.5. Certification of welder's qualifications shall be submitted to the Engineer before any welds are made.

B. Pipe Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code.

1.06 DELIVERY, STORAGE AND HANDLING

A. The supplier shall be responsible for shipping, delivery, and rigging costs.

B. Provide pipe end caps and other protective materials to keep all piping, valves and fittings clean and free from damage.

## PART 2 - PRODUCTS

2.01 FUEL OIL PIPING SYSTEM

A. General: Fuel oil piping and equipment shall be located as shown on the Plans. Coordinate piping with outside utilities and with equipment suppliers utilizing shop drawings or installation instructions. All piping shall be supported according to standard engineering practice. Pipe supports shall be suitable for outdoor use. Provide removable 10 gauge aluminum diamond plate protective covers over the exposed fuel oil pipes.

B. Aboveground Piping: Piping shall be ASTM A53, black steel, schedule 40, type E or S, Grade B. Piping exterior shall be coated with appropriate coating for outdoor service.

C. Fittings:

1. Malleable-Iron Threaded Fittings: ASTM A B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234, for butt and socket welding.

3. Unions: ASME B16.39, Class 150, ground joint, and threaded ends.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets.

2.02 FUEL OIL VALVES

A. Ball valves shall be two piece, full port, steel ball valve with stainless steel trim meeting API 607 standards and shall include the following features:

1. Threaded Ends: Comply with ASME B1.20.1.

2. Tamperproof Feature: Locking feature for valves if indicated on the Plans.

3. Body: Carbon Steel or Stainless Steel.

4. Stem: Stainless Steel, blowout proof.

5. Seats: Reinforced TFE, blowout proof.

**PART 3 - EXECUTION**

3.01 INSTALLATION

A. General: The Plans are generally diagrammatic and shall not be considered final layout. The location and quantity of piping and fittings on the Plans are for illustration only and careful coordination of the Work is necessary to avoid conflicts. Additional venting and low point drains may be required dependent on the final layout of piping.

B. Piping: Run all piping parallel or perpendicular to the building lines unless otherwise indicated.

3.02 JOINING PIPE

A. Join pipes with ASTM A 53, black steel, Schedule 40 threaded couplings and fittings.

B. Welder Filler Metals: Comply with AWS D10.12 for welded materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Equipment Connection: Flexible fuel oil supply and return piping connections at the standby engine generator shall be provided by the generator manufacturer.

3.03 TESTS

A. Piping: Piping shall be disconnected from tanks and equipment prior to testing. Piping shall be tested at 50 psig air pressure for a period of four (4) hours.

## END OF SECTION 23 11 13

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# SECTION 23 13 23 - ABOVE GROUND FUEL STORAGE TANK

## PART 1 - GENERAL

1.01 SUMMARY

A. The Work to be performed under this Specification includes furnishing and installing the Above Ground Diesel Fuel Storage Tank and related valves, fittings gauges, and accessories.

1.02 RELATED WORK

A. GENERAL HVAC REQUIREMENTS: Section 23 05 00.

B. FUEL OIL PIPING: Section 23 11 13.

C. ENGINE GENERATOR: Section 26 32 13.

1.03 QUALITY ASSURANCE

A. Minimum Standards: The materials, installations and workmanship furnished under this Technical Special Provision shall conform at least to the requirements of the Codes on force for this Site; however, materials, installations and workmanship indicated on the Plans, or herein specified which are in excess of the Code Requirements, shall be furnished as indicated and specified.

B. Reference Standards: Comply with provisions of the following, unless otherwise indicated or specified.

1. American National Standards Institute (ANSI):

a. Referenced standards.

2. American Society of Mechanical Engineers (ASME):

a. Referenced standards.

3. American Society for Testing and Materials (ASTM):

a. Referenced standards.

4. Florida Building Code, Latest Adopted Edition, as amended - Fuel Gas.

5. National Fire Protection Association (NFPA):

a. NFPA 30 Flammable and Combustible Liquid Code.

b. NFPA 31 Standard for the Installation of Fuel Burning Equipment.

c. NFPA 54 National Fuel Gas Code.

d. NFPA 70 National Electrical Code

e. NFPA 780 Lightning Protection Code.

6. Underwriters' Laboratory (UL):

a. UL 142 Steel Aboveground Tanks for Flammable and Combustible Liquids.

b. UL 2085 Protected Aboveground Tanks for Flammable and Combustible Liquids.

7. State of Florida Department of Environmental Protection (DEP):

a. DEP 62-762 Aboveground Storage Tank Systems (Latest Adopted Edition)

C. Qualifications of Welders: All welders employed for this Work shall be qualified under the requirements of ANSI B31.1.0, Section 127.5. Certification of welder's qualifications shall be submitted to the Engineer before any welds are made. Includes piping installer's and tank manufacturer's employees.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Warranty: The fuel tank shall be provided with a 20 year manufacturer's warranty.

1.04 SUBMITTALS

A. Provide all submittal requirements of TSP Sections 23 11 13 FUEL OIL PIPING and 23 13 23 ABOVEGROUND FUEL STORAGE TANK AND PIPING as one submittal package for review.

1. Shop drawings and erection drawings shall be submitted on the tank, pipe fittings, inlets and outlets, hold down locations, gauges assemblies, and accessories, including welder's certification.

2. Submit head loss/pressure drop calculations that show the total pressure drop of the fuel supply and return piping, including check valves, foot valves, 90 degree bends, etc. do not exceed the capabilities of the engine generator fuel pump. Ensure the engine fuel pump is capable of overcoming the pressure drop caused by the piping system.

3. Shop drawings shall be submitted of all tank accessories including but not limited to; gauge assemblies, level switches, fuel tank monitoring system, anti-siphon valves, leak detection system, analog fuel sensor, emergency vents, strainers and foot valves. The shop drawings shall indicate, at a minimum, the dimensions, materials of construction, and installation instructions.

4. Installation instructions for the tank shall be submitted.

5. Warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The supplier shall be responsible for shipping, delivery, and rigging costs.

B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic until it is installed.

1.06 WARRANTY

A. Provide tank manufacturer's general one (1) year warranty and a minimum (20) year warranty against tank failure due to corrosion or structural failure.

B. Refer to CONTRACT GENERAL PROVISIONS for additional requirements.

**PART 2 - PRODUCTS**

2.01 ABOVEGROUND FUEL STORAGE TANK

A. Furnish a 2,000 gallon aboveground, horizontal, double-wall type I, steel storage tank 5'4" in diameter by 12'0" long with Saddle supports. Tank shall be fabricated from mild carbon steel with flat-flanged heads. Minimum inner tank thickness 7 gauge head and shell. Minimum outer tank thickness 10 gauge head and shell. All items included with the tank shall be coated with red primer paint. The tank shall be manufactured in conformance with Underwriters Laboratories' UL-142 specifications and so labeled. Tank and Saddle supports shall have a final exterior white protective polyurethane or epoxy paint coating.

1. The unit shall be UL-142 Listed by the National Recognized Testing Laboratory (NRTL) and approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7 to provide procurement flexibility, and shall be a Florida Department of Environmental Protection (FDEP) approved tank with current FDEP EQ number.

B. The tank shall be fabricated with threaded connections as indicated on contract drawings, and/or 150# flanged connections with flange protectors at locations also indicated on contract drawings. Coordinate quantity, size and locations of all tank openings with manufacturer prior to placing order or submitting for approval. Thread protectors shall be inserted in all threaded openings prior to shipment.

C. Tank shall have the capability of physical monitoring between the primary tank and secondary containment. Provide one spare 2-inch opening. Refer to Plans for additional requirements.

D. A tank anchoring system shall be provided for the tank based on site specific conditions. If the tank is in an area subject to flooding, provisions shall be made to prevent the tank from floating during a rise in water up to the established maximum flood stage.

E. Fuel: Refer to Section 26 32 13 – ENGINE GENERATOR for diesel fuel requirements. The engine generator installer shall provide the fuel for the fuel tank.

F. Fuel storage tank shall be an atmospheric tank with an internal pressure less than 2.5 psi. Provide emergency vents as required by NFPA 30 to prevent internal pressure from exceeding 2.5 psi.

G. Access: Provide manufacturers standard stair access assembly to facilitate safe refueling operations

H. Product: Highland Tank or Approved Equal.

2.02 ANALOG LIQUID LEVEL SENSOR

A. Description: Provide a calibrated, analog electrical, liquid-level sensor as described below.

B. The liquid-level sensor shall be a continuous output liquid level sensor that provides a direct current signal that is proportional to the fluid height in the tank. The sensor shall provide a

continuous and linear current signal output from 4 mA when the tank is empty to 20 mA when the tank is full. The accuracy of the sensor shall be plus or minus 2% of the measured range with a resolution of 1/4". The sensor shall operate on 24 VDC supplied by the SCADA system control panel. The sensor shall be threaded into a 2-inch NPT port. The sensor stem and mounting material shall be constructed from brass. The float shall be Buna N material and compatible with #2 diesel fuel oil.

2.03 LIQUID LEVEL SWITCHES

A. Description: Fluid level magnetic switch floats shall be provided for detecting the high level and low level tank level alarm points in the fuel tank. Ensure each switch can operate in normally open or normally closed contact states. The tank high level alarm switch will be set at 90% of the tank full level. The low level alarm switch will be set at 30% of the tank full level. The floats shall be constructed of Buna N material, and the stems shall be constructed from brass. The visible and audible tank alarms will be annunciated at the fuel tank monitor panel.

B. Leak Detection: A leak detection magnetic float switch shall be provided in the secondary fuel tank to detect leakage into the secondary tank. The switch contacts shall be a hermetically sealed reed switch. The stem material shall be brass and the float material shall be Buna N. The visible and audible leak alarm will be annunciated at the fuel tank monitor panel.

2.04 DIRECT READING LIQUID LEVEL GAUGE

A. Install a direct reading liquid level gauge on top of the fuel tank and facing the fuel fill port. This gauge will be used during fuel filling operations to prevent overfilling the tank. The gauge shall be low profile with a cast aluminum body and a red indicator. The gauge markings will be E, 1/2, F. The operating arm that connects to the float shall be stainless steel and the float shall be HDPE material. The gauge shall be Kreuger Sentry catalog # GFK or approved equal.

2.05 FUEL TANK MONITOR (FTM) AND ALARM PANEL

A. FTM Description: Provide a calibrated, leak-detection and fuel level monitoring system with probes, float switches, sensor cables, conduits, and other components to make up a complete and functional system. Ensure the enclosure is rated NEMA 4 and is installed in close proximity to the tank fuel fill port such that the alarms will be noticed by the person filling the tank.

B. The fuel tank monitoring panel shall include an audible and visual leak detection alarm, high level alarm, and low level alarm. Separate alarm contacts are required in the panel for the high level, low level, and leak detection alarms. Where applicable, a SCADA system will monitor these contacts and provide for remote monitoring of the fuel tank alarms. The alarm contacts shall be rated for 120 Volts, 3 Amps. The FTM shall be Pneumercator, LC-1003-11, three channel alarm panel or approved equal.

2.06 AST OVERFILL PREVENTION VALVE

A. Provide AST overfill prevention valve to shut off flow of product entering tank when the liquid level reaches a preset warning level.

B. Provide Morrison Brothers Co., AST Overfill Prevention Valve 9095A or OPW 61fSTOP or approved equal.

2.07 EMERGENCY TANK VENT

A. Provide an emergency vent of adequate capacity and size for each fuel tank and any interstitial spaces within the tank. The emergency vent will be a weighted, mushroom-style emergency vent. When pressure builds up within the tank more than 2.5 psi, the weighted cast iron lid is forced up

off its seat to relieve the pressure. When pressure is relieved, the lid lowers and is automatically reset. The vent shall be OPW or approved equal.

2.08 NORMAL TANK ATMOSPHERIC VENT

A. Description: Provide a normal atmospheric vent cap and galvanized vent pipe of adequate capacity and size for each tank. The vent cap shall be constructed of cast aluminum and will be equipped with a 40-mesh brass insect screen. The vent cap shall be OPW or approved equal.

2.09 ANTI-SIPHON VALVES

A. Anti-siphon valves utilized for emergency fuel oil shutoff service shall include the following features and requirements:

1. Shall be compatible and suitable for use with diesel fuel oil.

2. Shall have an internal thermal expansion pressure relief mechanism.

3. Shall be UL or ULc listed and conform to Local, State and Federal Codes.

4. Shall be a listed and labeled Anti-Siphon valve per NFPA 30.

5. Valve body shall be Zinc plated ductile iron.

6. Spring material shall be Zinc plated or stainless steel.

7. Valve shall have a lockable and adjustable head pressure setting mechanism.

8. Adjustment screw and lock nut shall be stainless steel.

9. Adjustment mechanism shall have a durable weather cap.

10. Valve shall be provided with a mesh screen strainer on inlet.

11. Valve seals/discs shall be Flourocarbon or equivalent compatible with diesel fuel oil.

12. Valve shall be field adjusted for actual equipment piping layout and anti-siphon head requirements.

13. A manual bypass valve shall be installed such that the anti-siphon valve may be bypassed for maintenance or it fails to operate.

B. Products: Provide products by one of the following:

1. Franklin Fueling Systems (EBW), Model 605-300-01 Anti-Siphon Valve.

2.10 FOOT VALVE

A. Description: A double poppet foot valve with 20 mesh screen shall be provided on the fuel suction tube located 3” from the bottom of the tank or as recommended by tank manufacturer. The valve body and poppet shall be brass.

2.11 EXTRACTOR FITTING

A. Description: A 2” x 2” x ¾” tee fitting with female pipe threads shall be utilized as an extractor fitting for the foot valve.

2.12 FILL PORT

A. Description: A 2" carbon steel fill port which includes inlet and spout adapter with dust cap.

B. Ensure the fill port is enclosed by a 7-gallon, liquid tight, UL listed metal spill containment enclosure with a hinged metal cover. The hinged metal cover shall be equipped with a hasp for pad locking the cover closed. The overfill containment enclosure shall include a ball valve and a return line to return spilled fuel back to the primary tank.

2.13 GROUNDING

A. Description: Aboveground tanks shall be grounded to provide lightning protection in accordance with NFPA 780.

B. Grounding Rod: Grounding rod shall not be less than 5/8" in diameter and 8 feet long and shall meet the requirements of NFPA 780.

C. Ground Terminals and Conductor Cable: Terminal and Cables shall be in accordance with NFPA 780.

2.14 TANK SIGNAGE

A. Provide tank with OSHA and ANSI compliant permanent safety signs to indicate the following:

1. TYPE GRADE AND CLASS OF LIQUID IN TANK
2. HAZARD/DANGER
3. COMBUSTIBLE LIQUID
4. VOLUME OF TANK
5. NO SMOKING
6. NO OPEN FLAME

B. Identification shall be positioned so that it can be easily seen from the normal angle of approach.

C. Signage shall be in accordance with Technical Special Provision 10 14 00 – SIGNAGE.

**PART 3 - EXECUTION**

3.01 INSTALLATION

A. General: The Plans are generally diagrammatic. Every bend, off-set, elbow or other fitting that is required, may not be shown for the piping installation. Careful coordination of the Work is necessary to avoid conflicts.

B. Piping: Run all piping parallel or perpendicular to the building lines unless otherwise indicated.

C. Install tank and accessories in accordance with all/each manufacturer's written instructions and in

accordance with NFPA 30.

D. Provide unions, couplings, bushings, etc. as required to provide a complete and operational installation.

E. Install the fuel tank on a concrete pad that extends a minimum of 4 inches above grade.

3.02 JOINTING PIPE

A. Equipment Connection: Flexible fuel oil supply and return piping connections at the standby engine generator shall be provided by the generator manufacturer.

B. Dielectric Connections: Provide dielectric unions between dissimilar metals and at connections to the tank and all equipment. Do not use steel and copper piping in the same system without isolation.

C. Prohibited Fittings: Screwed bushings are prohibited, except where available space prevents use of reducing couplings. Pipe reductions on horizontal piping shall be made with eccentric reducers. Top of piping shall be flat for venting. The bottom of vent and return lines shall be flat for drainage.

3.03 TESTS

A. Piping: Piping shall be disconnected from tank and equipment prior to testing. Piping shall be tested at 50 psig air pressure for a period of four (4) hours.

B. Tank and connections shall be tested for tightness after installation and before being placed into service in accordance with NFPA 30.

## END OF SECTION 23 13 23

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# SECTION 23 81 00 - PACKAGED AIR CONDITIONERS

## PART 1 - GENERAL

1.01 SUMMARY

A. Furnish and install packaged self-contained, exterior, vertical, wall mounted air conditioning unit including all controls, monitoring, related attachments and accessories required for a complete and operable system as indicated on the Contract Drawings and specified herein. Air conditioning unit will be sized for 100% of the building heat loads.

B. Each air conditioning unit shall be capable of maintaining the regulator equipment building at 78 degrees Fahrenheit (plus or minus 2 degrees) with 50% relative humidity (plus or minus 5%) when the outside ambient air is at design conditions.

1.02 RELATED SECTIONS

A. GENERAL HVAC REQUIREMENTS: Section 23 05 00.

1.03 QUALITY ASSURANCE

A. Performance Requirements:

1. Comply with performance and efficiency requirements of the following:

a. Air-Conditioning & Refrigeration Institute (ARI) Standards:

- ARI210 Unitary Air-Conditioning Equipment.
- ARI270 Sound Rating of Outdoor Unitary Equipment.

b. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):

- ASHRAE 52 Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- ASHREA/ANSI 90.1-2016

c. Underwriters' Laboratories (UL):

- Reference Standards.

B. Certification Requirements:

1. Unit shall meet certification requirements of the following:

a. Air-Conditioning & Refrigeration Institute (ARI) Standards:

- ANSI/ARI Standard 390-2003 for SPVU (Single Packaged Vertical Units) with ARI Certificate for min. 10.0 EER and 12.0 IPLV

b. Intertek ETL Listed to:

- Standard for Safety Heating and Cooling Equipment ANSI/UL 1995/CSA 22.2 No. 236-05 Fourth Edition.

1.04 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for packaged air conditioning unit (AC). Include the rated capacity, sensible capacity, operating characteristics, rough-in dimensions (as applicable), rigging procedures, service connection requirements, drain connections, performance ratings, materials, manufacturer's model numbers, power/electrical requirements and wiring diagrams showing connection points for the thermostat / unit controller.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency AC systems.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Provide operation, maintenance and parts manuals in accordance with items 1 through 5 below.

1. Provide one CD ROM copy and one paper book copy of the Packaged AC system manufacturer’s parts manuals for each building under this contract. The parts manuals must show the original equipment manufacturers part numbers for all parts and accessories included with the packaged terminal air conditioner units.

2. Provide one CD ROM copy and one paper book copy of the Packaged AC system manufacturer’s service and repair manuals for each building under this Contract.

a. The service and repair manuals shall include the manufacturer’s suggested preventive maintenance service activities, suggested intervals between each service, and the required parts and tools to perform the service.

b. The service and repair manual will include separate chapters on each subsystem or major component of the Packaged AC systems. Each chapter will provide exploded view diagrams, required tools, and step by step procedures to repair or replace each component in the subsystem.

3. Turn over the CD ROM and paper parts manual book and the CD ROM and paper service manual book to the Construction Engineering & Inspection (CEI) firm when the site is turned over to the Owner.

4. The Construction Engineering & Inspection representative will accept the paper and CD ROM copy of the manuals and provide a written receipt to the contractor to show that the manuals were received and are awaiting review. The contractor will submit an electronic copy of the manuals to the Owner for review as a Shop Drawing.

5. If the manuals are incomplete, or are lacking in meaningful parts information or step by step repair instructions, or do not cover the model or type of equipment being provided, then the Owner may REJECT the manuals and indicate on the shop drawing review forms the nature of the deficiencies. The contractor will then collect the deficient materials from the CEI, correct the deficiencies, and then re-submit the materials for another review.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver Packaged AC system (s) in factory-fabricated containers designed to protect units and finish until final installation.

B. Store Packaged AC system (s) in original containers and in location to provide adequate protection to unit(s) while not interfering with other construction operations.

C. Handle Packaged AC system (s) carefully to avoid damage to components, enclosures, and finish. Do not install damaged equipment; replace and return damaged components to equipment manufacturer.

1.08 WARRANTY

A. Packaged AC system (s) shall have a warranty that guarantees the AC systems are free from defects in materials and workmanship for a period of five (5) years for parts including compressor and refrigeration circuit components. Shipping and labor is not covered by the warranty. The warranty period shall commence on the date that the Owner accepts the completed building.

B. Submit a written copy of the warranty for each Air Conditioner system, registered online by the contractor on behalf of the owner. Ensure the Owner is listed, with the physical address of the building that the unit is being installed on. Ensure the physical address shown on the warranty is the same address as shown on the building utility bill.

**PART 2 - PRODUCTS**

2.01 MANUFACTURED UNITS

A. Bard Mega-Tec Packaged Air Conditioning System with LC6000 Controller.

B. Model Number: W120AEB18BP1X2 (Verify via submittal process prior to ordering equipment).

C. Description: High performance, outdoor vertical, packaged, wall mounted AC system. Single zone cooling with electric reheat dehumidification utilizing dual compressors with a total of three stages of cooling capacity.

D. Performance Rating: Cooling capacity of unit(s) shall meet the sensible heat and total heat requirements determined per design calculations and stated on the Contract drawings. If selecting an alternate unit or size, make true allowance for "sensible to total heat ratio" to satisfy the sensible cooling capacity.

E. Air Conditioning unit(s) (AC) shall be factory assembled, wired and tested.

2.02 COMPONENTS

1. General:

a. Provide with factory wall installation bracket.

b. Contained within the unit(s) shall be all factory wiring and internal piping, control circuit board and fan motor.

2. Cabinet:

a. Unit cabinet construction shall be comprised of 16 gauge Zinc coated steel. All parts shall be cleaned, rinsed, sealed, and dried before application of polyurethane primer.

b. Final factory cabinet coating shall be white, baked on textured enamel. Factory finish shall be designed to withstand 1000 hours of salt spray tests per ASTM B117-03.

c. Cabinet shall be insulated with ¾" thick durable closed cell foam insulation with and installed R-Value of 2.78.

d. Filter access doors shall be hinged for easy access to filters, electric heat, controls and evaporator area.

e. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, support, and other installation accessories required to meet Hurricane Code Conditions shall be provided as required for compliance at no addition cost to Owner.

3. Evaporator Fan:

a. Evaporator Fan shall be industrial grade ECM indoor fan assembly that maintains High efficiency operation across entire operating range.

b. Fan Controller shall utilize Modbus communication to provide accurate fan control via the unit logic board and provide a reduction in energy use when the motor is run at reduced speeds.

c. Fan motor shall be ball bearing construction with over temperature protection, soft start, and an integrated controller for Modbus communication.

d. Impeller shall be aluminum with steel frame construction.

e. The fan(s) shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.

4. Ventilation Options:

a. Provide unit constructed without economizer vent option, outside air intake and exhaust openings. Unit shall include a blank-off to eliminate fresh air intake and exhaust.

5. Filter:

a. Provide unit with 2" MERV 8 return air filter(s) as indicated on plans.

b. Filter shall be easily removed for service and replacement.

6. Evaporator Coils:

a. The evaporator coil shall be of nonferrous construction with mechanically expanded copper tubing with enhanced surface flat aluminum fins. Aluminum fins shall have a hydrophilic coating to aid in condensate drainage, inhibit mold growth and protect aluminum fins from oxidation.

c. All tube joints shall be brazed with PhosCopper or silver alloy.

e. The coils shall be pressure tested and leak tested at the factory.

f. A condensate drain pan with a drain shall be factory provided under the evaporator coil.

g. A condensate drain pan liquid level switch shall connect to the unit control board, and if actuated will stop the AC from running to prevent condensate from overflowing the drain pan. An alarm shall be initiated simultaneously.

7. Refrigeration System:
Provide unit with Electric Reheat Dehumidification to control humidity in the space by allowing concurrent compressor and electric heat operation. Default electric reheat dehumidification set point shall be 60%RH (adjustable) zone humidity and above.

8. Refrigeration System:

a. The refrigeration system shall consist of dual compressors, dual circuits and include liquid line filter driers, Electronic Expansion Valves (EEV) and high-pressure safety switches. Refrigeration system shall use R-410A. Refrigerant piping shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements.

b. Electronic Expansion Valves shall be certified in accordance with National and International standards. Accurate flow control shall be achieved via communication between the EEV and the unit logic control board. The EEV shall be designed to optimize management of air conditioning and refrigeration systems, with priority on reduction of energy consumption.

9. Condenser Section:

a. Access to compressors, filter-driers, damper motor/linkage, and evaporator drain hoses shall be behind the condenser fan. The condenser fan shall be mounted on a sliding carriage for access to the interior of the condenser section. A safety switch shall be provided on access to the condenser section. Follow all safety instructions provided in the unit installation and service manual provided the manufacturer.

b. The outdoor unit shall be capable of cooling operation down to 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required).

c. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.

10. Condenser Fan:

a. Condenser Fan shall be industrial grade ECM outdoor fan assembly that maintains High efficiency operation across entire operating range.

b. Fan Controller shall utilize Modbus communication to provide accurate fan control via the unit logic board and provide a reduction in energy use when the motor is run at reduced speeds.

c. Fan motor shall contain reverse polarity and locked motor protection.

d. Fan blades shall be aluminum sprayed with PP plastic.

e. Protective grille shall be steel coated with PP plastic.

f. Finished fan assembly shall have a durable black gloss enamel paint finish.

11. Condensing Coil:

a. The air cooled condenser coil shall be constructed of mechanically expanded copper tubing with enhanced surface flat aluminum fins to reduce debris build up and allow maximum airflow. Components shall be rated for up to 110-degrees F ambient. The coil shall be protected with an integral metal guard.

b. Condensing coil shall be provided with a Factory Applied corrosion resistant TechniCoat 10-2™ coating. TechniCoat is a proprietary epoxy-modified phenolic dip coating. Coils shall be subjected to full immersion to ensure complete coverage without significant loss of thermal efficiency. Application shall be a 4-step coating system consist of (1) a multi-step cleaning process, (2) chemical etch primer, (3) epoxy-modified phenolic, and (4) phenolic sealer. The result shall be a corrosion resistant coil that outperforms a copper finned coil. ASTM B117 salt spray tests shall show over 4500 hours with “no fin corrosion or degradation.”

c. Refrigerant flow from the condenser shall be controlled by means of an electronic expansion valve (EEV) metering device.

12. Compressors:

a. Each refrigeration circuit shall use a separate Scroll Compressor. Circuit 1 shall be two-stage. Circuit 2 shall be single-stage. Unit PLC shall control three stages of cooling to provide efficient capacity control and matching of internal heat loads.

13. Electrical:

a. The electrical power of the unit shall be as indicated on plans and coordinated with Electrical Contractor. The unit shall be capable of satisfactory operation within specified customary voltage limits.

14. Factory Options to be supplied with AC Unit:

a. Programmable Logic Board (PLC) - Furnish unit with a programmable logic board located inside the unit control panel to communicate with the LC6000 controller. Alarm functionality and unit operational commands shall be communicated by 2-wire connection. Upon loss of communication, the unit shall continue to run by using the logic embedded in the unit controller and operate in orphan mode status.

b. High Pressure Transducer (HPT) – Furnish unit with a high pressure transducer for monitoring high side system pressures. High pressure measurements shall be accessed through the unit software. The outdoor fan speed controller shall utilize the high pressure

transducer input to control High system pressure during hot weather compressor cooling operation.

c. Low Pressure Transducer (LPT) – Furnish unit with a low pressure transducer for monitoring low side system pressures. Low pressure measurements shall be accessed through the unit software. The low pressure transducer shall be used for low ambient outdoor temperature conditions. The outdoor fan speed controller shall utilize the low pressure transducer to control low system pressure during cold weather compressor cooling operation.

d. High Pressure Control (HPC) – Furnish unit with high pressure control to provide a means of protecting each individual refrigeration circuit when extremely high system pressures occur. HPC shall be an auto-reset device that is connected to the Compressor Control Module. When activated, the compressor in the refrigeration circuit shall be disabled until the alarm is cleared in the controller, or power to the unit is reset.

e. Compressor Control Module (CCM) – Furnish each refrigerant circuit with an individual compressor control module. The compressor control module shall lock out compressor operation to protect the refrigeration system based on signals from the High pressure switch. CCM shall provide diagnostics to indicate when a refrigerant pressure event occurs, and also sends a signal to the PLC. Low incoming voltage protection shall suspend compressor operation when incoming voltage is too low to avoid reverse scroll operation. The voltage protection feature shall include adjustable timing. An adjustable delay on break timer shall be provided. Delay on make is 2 minutes plus 10% of delay on break setting.

f. Crankcase Heater (CCH) – Furnish unit with a belly band heater that is installed around the base of the compressor and applies heat when the refrigeration system is not operational. This heat is meant to prevent refrigerant oil migration when the unit is not running.

g. Outdoor Air Temp/Humidity Sensor (OAT) (OAH) – Furnish unit with outdoor sensor to measure outdoor temperature and humidity. Temperature and humidity information shall be used for unit operation.

h. Dirty Filter Switch Indicator (DFS) – Furnish unit with Dirty Filter Indicator that is adjustable and measures pressure drop across the unit filter surface. When pressure drop is exceeds the switch setting a signal shall be sent to the PLC to indicate a filter change is necessary. Provide with indicator light located on the exterior of the unit to indicate filters need to be replaced.

i. Discharge (Supply) Air Sensor (SAT) – Furnish unit with a discharge air temperature sensor to provide a temperature reading of the supply air leaving the unit. The sensor shall be a 10K OHM @ 77°F measuring device installed in the supply airstream after the evaporator coils.

j. Return Air Temperature Sensor (RAT) – Furnish unit with a return air sensor to provide a temperature reading of the room air entering the unit. The sensor shall be a 10K OHM @ 77°F measuring device installed in the return airstream behind the return grille.

k. Freeze Sensor (FS) – Furnish unit with a 10K freeze sensor to monitor the evaporator coil temperatures, and protect the system from evaporator frost buildup/freeze. Each evaporator coil shall have a sensor attached to the coldest location of the coil circuitry.

l. Evaporator Fan Airflow Switch (AFS) – Furnish unit with an airflow switch that measures the pressure differential between the Evaporator Fan inlet and outlet. An alarm signal shall be sent to the PLC to indicate if the Evaporator Fan is not functioning.

m. Door Switch (DS) – Furnish unit with Door Switches to disable unit operation when service panels are removed from the unit.

n. Electronic Expansion Valve (EEV) – Furnish unit with EEV to control unit superheat via low side system pressure and temperature. Unit PLC shall use unit sensors, including low side pressure and temperature, to control each refrigerant circuit independently. The EEV shall have a coil that can be removed and replaced without circuit refrigerant removal. During maintenance, the EEV shall be opened or closed through the unit software or with a manual adjustment tool.

2.03 CONTROL SYSTEM

A. The AC unit control system shall be BARD MEGA-TEC LC6000 and shall consist of sensors thermostat, humidistat, indicators, final control elements, interface equipment, other apparatus, and accessories to control AC unit systems such that the programmed temperature and humidity is maintained within the building.

B. Control system shall include a solid state microprocessor based controller designed to operate a single, multiple or redundant air conditioning system(s) with the following requirements:

1. Factory programmed with capability to field reprogram set points per Owner preferences.

2. Lead/Lag controller to be programmed to operate AC units to insure equal wear on units while allowing the Lag unit(s) to assist upon demand.

3. Program settings should be retained during indefinite power loss to the controller.

4. Lag unit automatically becomes Lead unit if lead unit loses power.

5. The unit controller shall utilize 24 VAC and 24 VDC control power derived from the AC unit.

C. LC6000 unit controller shall contain separate NO/NC alarm output contacts that will change state to indicate each of the following alarm conditions:

1. Loss of 208 VAC to unit.

2. Loss of 24 VAC control voltage unit.

3. Lock out - High refrigerant pressure alarm.

4. High indoor temperature alarm set at 90 degree F.

5. Low indoor temperature alarm set at 40 degree F.

6. High Humidity alarm set at 70% RH.

9. Smoke detector initiated.

10. Generator Run Alarm.

11. Auxiliary 1.

12. Auxiliary 2.

2.04 SEQUENCE OF OPERATION

A. Cooling Operation: The Dual Compressor AC unit shall offer three stage cooling operation using R410A refrigerant. Cooling shall be achieved via two independent cooling circuits containing independent scroll compressors (one two stage, one single stage), filter driers, electronic expansion valves (EEV's), condenser coils and evaporator coils. The unit PLC shall monitor indoor humidity levels, and use High sensible cooling operation to increase unit airflow when moisture levels do not require an average or substantial amount of latent capacity.

B. The unit Controller shall operate the AC system in the Regulator building. AC unit shall be equipped with a two-stage compressor refrigeration circuit and a second single-stage compressor refrigeration circuit. The AC Unit shall have an adjustable factory time delay for compressor short cycle protection.

C. On a call for cooling, the unit will start operation in the low capacity mode (1st stage) to maintain the building temperature at the programmed thermostat set point. If the temperature in the building rises above the set point for five minutes (adjustable), the controller will start the (2nd stage) capacity mode. If the temperature in the building rises above the set point for five minutes (adjustable), the controller will start the (3rd stage) full capacity mode. When the building temperature drops below the set point, stages of capacity will shut off as required to match room load. Upon a subsequent call for cooling the process will repeat.

D. Electric Reheat Dehumidification mode shall control humidity in the space by allowing concurrent compressor and electric heat operation. Electric Reheat operation shall enabled by the LC6000 controller when humidity levels exceed set point in the area being conditioned. Default LC6000 electric reheat dehumidification set point shall be set to 60%RH (adjustable) zone humidity and above.

**PART 3 – EXECUTION**

3.01 INSPECTION

A. Examine rough-in electrical services and installation of floors and walls and other conditions under which packaged units are to be installed. Verify dimensions of services and substrates before installing units.

3.02 INSTALLATION

A. Install unit in strict accordance with manufacturer's recommendations and instructions; adjust to correct height and level.

B. Seal all voids and openings weather tight.

C. Provide weather flashing at top of unit.

D. Provide adequate drainage for condensate system.

E. Secure unit to comply with Building Code requirements for wind loading.

3.03 CLEANING

A. After completion of installation and completion of other work in surrounding areas, remove protective coverings, if any, and clean Packaged systems, internally and externally.

3.04 EXTRA PARTS

A. Provide one set of spares filters for each unit.

## END OF SECTION 23 81 19

# TECHNICAL SPECIFICATIONS

# DIVISION 26
# ELECTRICAL

# SECTION 26 05 01 - BASIC ELECTRICAL REQUIREMENTS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and other Division 26 Specification sections apply to this section.

B. All systems, equipment, materials, and accessories that are assembled or installed for the Project shall comply with the:

1. Florida Building Code, Latest Adopted Edition, as amended.

2. National Electrical Code, Latest Adopted Edition.

3. Florida Fire Prevention Code and the publications as referenced in NFPA 1 – Uniform Fire Code (Florida's Latest Adopted Edition) and NFPA 101 – Life Safety Code (the Florida Latest Adopted Edition).

4. Federal Aviation Administration (FAA) – Applicable Design Standards

5. Illumination Engineering Society of North America (IESNA) – Latest edition of IES Handbook

1.2 SUMMARY

A. This section includes Basic Electrical Requirements specifically applicable to Division 26 Sections.

1.3 DESCRIPTION

A. Provide and install all equipment, labor, material and accessories, and mounting hardware for a complete and operating system as described within these Division 26 Specification Sections.

B. Furnish, perform, or provide all labor including planning, purchasing, transporting, storing, installing, testing, cutting and patching, trenching, excavating, backfilling, coordination, field verification, equipment (installation and safety), supplies, and materials necessary for the installation of complete electrical systems (as described or implied by these specifications and the applicable drawings) in strict accordance with applicable codes, which may not be repeated in these specifications, but are expected to be common knowledge of qualified Bidders.

C. All work shall comply with all applicable codes as a minimum and with the additional requirements called for in these Contract Documents.

D. Only trained and licensed personnel shall perform work. No Work shall be performed which violates applicable Codes, even if called for in the Contract Documents.

E. Coordinate and verify power and telephone company service requirements. Submitted bid shall include all work required.

F. Make connections of all items in the Work using electric power including wire, conduit, circuit protection, disconnects and accessories. Securing of roughing-in drawings and connection

information for equipment involved shall also be included under this division. See other divisions for specifications for electrically operated equipment.

G. The Contractor shall provide and install panic hardware on all electrical room doors where the electrical room houses switchboards or MCC's rated 1200 amps or more per NEC 110.26. All electrical room doors shall open in the direction of egress.

1.4 QUALITY ASSURANCE

A. Install Work in locations shown or described in the Contract Documents, unless prevented by Project conditions.

B. Install all equipment so that all Code and Manufacturer recommended working and servicing clearances are maintained. Properly arrange and install all equipment within designated spaces. If a departure from the Contract Documents is necessary, submit to the engineer for approval, detailed drawings of the proposed changes with written reasons for the changes. No change shall be implemented without the issuance of a change order or other directive permitted by the General Conditions.

C. The Contractor shall verify finish dimensions at the project site in preference to using dimensions noted on Contract Documents.

1.5 CONTRACT DOCUMENTS

A. The drawings are diagrammatic and are not intended to include every detail of construction, materials, methods, and equipment. They indicate the result to be achieved by an assemblage of various systems. Coordinate equipment locations with Architectural and Structural drawings. Layout equipment before installation so that all trades may install equipment in spaces available. Coordinate installation in a neat and workmanlike manner. Provide 1/4" scale coordination drawings per specifications prior to start of work.

B. Contractor shall provide 1/4" scale coordination drawings for all electrical, mechanical and communications rooms during the shop drawing submittal phase, utilizing detailed dimensions from equipment actually submitted (all disciplines) and field-measured/verified existing conditions. These drawings are also required for any room where conduits equal to or over 1-1/4" in size, equipment (panels, HVAC, disconnects, comm. racks) or other large objects are being installed. Drawings shall show all electrical, mechanical, plumbing, fire protection, structural, etc. coordinated so that problems are discovered/prevented prior to installation. Claims during construction for additional funding in rooms where properly coordinated drawings were not submitted will not be considered.

C. Wiring arrangements for equipment shown on the drawings are intended to be diagrammatic and do not show all required conductors and functional connections. All such items incidental to a complete and operating system shall be provided.

D. Submit specific shop drawings which indicate the fabrication, assembly, installation, and erection of particular systems' components. Drawings that are part of the Contract Documents shall not be considered a substitute for required shop drawings, field installation drawings, code requirements, or applicable standards.

E. Locations indicated for outlets, switches, and equipment are approximate and shall be coordinated with the Contract Documents. Where instructions or notes are insufficient to locate the item, notify the engineer.

## 1.6 MATERIALS AND EQUIPMENT

A. Unless otherwise noted, all material shall be new and UL listed or labeled. In lieu of UL listing or labeling, a statement or data demonstrating compliance with contract documents from a nationally recognized testing agency shall be submitted to the ENGINEER.

B. Where Contract Documents list design selection, manufacturer or type, this model shall set the standard of quality and performance required. Where no brand name is specified, the source and quality shall be subject to Designers/ENGINEER review and approval. Where Contract Documents list approved substitutions, these items shall comply with Division 01 requirements for substitutions.

C. When a product is specified to be in accordance with a trade association or government standard and at the request of Designers/ENGINEER the Contractor shall furnish a certificate that the product complies with the referenced standard and supporting test data to substantiate compliance.

D. Where multiple items of the same equipment or materials are required, they shall be the product of the same Manufacturer.

E. Prior to placing equipment orders, verify the physical size of specified equipment to fit spaces allotted on the drawings and with NEC working clearances. Internal access for proposed equipment substitutions shall be provided. Provide 1/4” scale drawings showing that this coordination has taken place.

F. Electrical equipment shall be protected from the weather, during shipment, storage, and construction per manufacturer's recommendations. Should any apparatus be subjected to possible damage by water, it shall be thoroughly dried and put through a dielectric test, at the expense of the Contractor, to ascertain the suitability of the apparatus, or it shall be replaced without additional cost to the Owner.

G. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service. Replace or repair and test damaged equipment in compliance with industry standards at no additional cost to the Owner. Equipment required for the test shall be provided by the Contractor.

H. Material and equipment shall be provided complete and shall function up to the specified capacity/function. Should any material or equipment as a part or as a whole fail to meet performance requirements, replacements shall be made to bring performance up to specified requirements. Damages to finish by such replacements, alterations, or repairs shall be restored to prior conditions, at no additional cost to the Owner.

## 1.7 SUPERVISION OF THE WORK

A. Reference the General Conditions for additional requirements.

B. A qualified and experienced electrical superintendent shall be in charge of the work in progress at all times. If, in the judgement of the ENGINEER, the electrical superintendent is not performing his duties satisfactorily, the Contractor shall immediately replace him upon receipt of a letter of request from the ENGINEER. Once a satisfactory electrical superintendent has been assigned to the work, he shall not be withdrawn by the Contractor without the written consent of the ENGINEER.

C. Provide field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable sizes and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected. All work performed by a non-

licensed Journeyman shall be under the direct supervision (in the presence of) of a Licensed Journeyman as specified herein. Increase the quantity of licensed Journeymen as required for supervision of all areas where direct contact is not possible.

D. Superintendent shall be employed by a State Registered (Type "E.R." License) or State certified (Type "E.C." License) electrical contractor.

1.8 COORDINATION

A. Provide all required coordination and supervision where work connects to or is affected by work of others, and comply with all requirements affecting this Division. Work required under other divisions, specifications or drawings to be performed by this Division shall be coordinated with the Contractor and such work performed at no additional cost to Owner.

B. Provide electrical subcontractor a set of Contract Documents for all areas of Electrical Work.

C. Installation studies shall be made to coordinate the electrical work with other trades. Work shall be preplanned. Unresolved conflicts shall be referred to the ENGINEER prior to installation of the equipment.

D. Coordination drawings shall be prepared prior to the start of work. Drawings shall show the actual physical dimension required for the installation to assure proper integration of equipment with building systems and NEC required clearances. Location of conduit racking, etc., shall be provided. Coordination drawings shall be provided for all areas. Comply with the requirements of Division 01.

E. Secure approved shop drawings from all required disciplines and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from that shown or called for in Construction Documents, make adjustments to the wiring, disconnects, and branch circuit protection to match that required for the equipment installed. Adjustments to contract value will not be considered due to lack of coordination.

F. Damage from interference caused by inadequate coordination shall be corrected at no additional cost to the Owner.

G. Coordinate the exact location of floor outlets, floor ducts, floor stub-ups, etc. with ENGINEER and Designer (and receive their approval) prior to rough-in. Locations indicated in Contract Documents are only approximate locations.

H. The Contract Documents describe specific sizes of switches, breakers, fuses, conduits, conductors, motor starters and other items of wiring equipment. These sizes are based on specific items of power consuming equipment (heaters, lights, motors for fans, compressors, pumps, etc.). Coordinate the requirements of each load with each load's respective circuitry shown and with each load's requirements as noted on its nameplate data and manufacturer's published electrical criteria. Adjust circuit breaker, fuse, conduit, and conductor sizes to meet the actual requirements of the equipment being provided and installed and change from single point to multiple points of connection (or vice versa) to meet equipment requirements. Changes shall be made at no additional cost to the Owner.

1.9 PROVISION FOR OPENINGS

A. Locate openings required for work. Provide sleeves, guards or other approved methods to allow passage of items installed.

B. Coordinate with roofing Contractor on installation of electrical items which penetrate the roof. Roof penetrations shall be installed so as to not void roof warranty.

C. Where work pierces waterproofing, it shall maintain the integrity of the waterproofing. Coordinate roofing materials which pierce roof for compatibility with membrane or other roof types with Contractor.

1.10 CONCRETE PADS

A. Furnish and install reinforced concrete pads where indicated on the plans for transformers, switchgear, generators, motor control centers, and other free-standing equipment. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by six (6) inches each side, except when equipment is flush against a wall where the side against the wall shall be flush with the equipment. Pads shall be reinforced with W1.4 x 1.4 6 x 6 welded wire mesh. Chamfer top edges 1/2". Trowel all surfaces smooth. Provide 3000 psi concrete.

1.11 SURFACE MOUNTED EQUIPMENT

A. Surface mounted fixtures, outlets, cabinets, conduit, panels, etc. shall have finish or shall be painted as directed by designer. Paint shall be in accordance with applicable sections and/or divisions of these specifications.

1.12 CUTTING AND PATCHING

A. New Construction:

1. Cutting of work in place shall be cut, drilled, patched and refinished by trade responsible for initial installation.

2. Backfill new grades to match adjacent undisturbed surface.

1.13 INSTALLATION

A. Erect equipment to minimize interference and delays with the execution of the Work.

B. Take care in erection and installation of equipment and materials to avoid marring finishes or surfaces. Any damage shall be repaired or replaced as determined by the designer/ENGINEER at no additional cost to the Owner.

C. Equipment requiring electrical service shall not be energized or placed in service until ENGINEER is notified and is present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another Contractor or the ENGINEER, notify the ENGINEER in writing as appropriate when the equipment will be ready.

D. Equipment supports shall be secured and supported from structural members unless written approval is granted by ENGINEER.

E. Plywood material shall not be used as a backboard for mounting panel boards, disconnects, motor starters, and dry type transformers. Provide "cast in place" type inserts or install expansion type

anchor bolts. Electrical equipment shall not be mounted directly to dry wall for support without additional channels as anchors. Channels shall be anchored to the floor and structure above. Panelboards and terminal cabinets shall be provided with structural framing located within drywall partitions.

F. Inserts, pipe sleeves, supports, and anchorage of electrical equipment shall be provided. Where items are to be set or embedded in concrete or masonry, the items shall be furnished and layout made for setting or embedment thereof so as to cause no delay.

G. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the ENGINEER.

1.14 AS-BUILT DOCUMENTS

A. As-Built Documents: As-built Documents include Drawings, Shop Drawings, Specifications, Addenda, Change Orders, and other modifications permitted by the General Conditions.

B. Refer to contract general provisions for additional requirements.

C. Verify aspects of redlined as-builts for accuracy. As-Built Documents shall show all components including but not limited to:

1. All raceways 1-1/4" and above, cable tray systems, and grouped raceway racking as installed, including dimensions from fixed building lines such as column lines.

2. All site underground raceways and duct banks indicating burial depths and distances from fixed building lines or global tracking coordinates.

3. Underground pull boxes and manholes including elevations. Detail manhole and pull boxes, conduit terminations (butterfly layout) including conduit sizes, designated systems and cabling description.

4. General conduit routing from receptacle to receptacle, fixture to fixture, device to device. (Exact routing is not required for raceways 1” and smaller.)

5. Lighting: Diagrammatically show junction boxes that are located above accessible ceiling with flexible conduit connections to luminaries.

6. Junction box splices shall be shown in exact location and clearly noted referring to the written authorization by the ENGINEER.

7. The first junction box within each homerun, regardless of size shall be shown in the installed location.

8. All junction boxes and pull boxes located above non-accessible ceilings shall be shown in exact location. All junction boxes 6”X6” and larger shall be shown in exact location.

9. Any combining of circuits (which is only allowed by specific permission) or change in homerun outlet box shall be indicated.

10. Any circuit number changes.

11. All conductors and cables, conductors and cable sizes, raceway sizes, etc not shown on contract documents and any changes from the documents.

12. Any switchboard, panelboard, motor control center, relay panel, or dimming control panel schedule changes, including load changes.

13. All access panels.

14. All existing conditions.

15. Location of lighting control devices such as photocell controls, space occupancy sensors, etc.

16. Exact quantity of conductors and cables shall be shown for all raceway systems.

17. All devices, wall outlet boxes, and control components.

18. All wireway and cable tray systems.

19. Exact location of all driven grounding electrodes including burial depths and dimensions from fixed building lines. Location of all grounding system busbars.

20. All building control panels and associated electrical devices, connections, power supplies, and dampers.

21. Riser diagrams exactly as installed.

22. Motor control devices, terminal cabinets, equipment racks, disconnects and switches and surge protection devices.

23. Change the equipment schedules (i.e. symbol legends, light fixture schedule, etc) to agree with items actually furnished.

24. Change plan notes to agree with items actually furnished, actual installation methods, etc. respectfully.

25. Cross-out all items, circuitry, devices, etc. not applicable.

D. As-Built red line information shall not compromise the clarity of the Contract Documents and Shop Drawings. Major components such as grouped raceway assemblies, cable tray systems, larger conduits, duct banks, racking, elevations, dimensions, etc. shall be shown on a clean architectural base plan(s) separate from the Contract Electrical Documents, as required to clearly delineate work. Obtain electronic base plan file from ENGINEER.

1.15 "OBSERVATION OF WORK" REPORT

A. Reference the General Conditions.

B. Items noted by designer/ENGINEER during construction and before final acceptance which do not comply with the Contract Documents will be listed in a "Observation of Work" report which will be sent to the Contractor for action. Correct all deficiencies in a prompt concise manner. After completion of the outstanding items, provide a written confirmation report for each item. The report shall indicate each item noted, and method of correction. Enter the date on which the item was corrected, and return the signed reports so items can be rechecked. Failure to correct the deficiencies in a prompt concise manner or failure to return the signed reports shall be cause for disallowing request for payments.

C. The electrical project superintendent shall be present at all required observation of work reviews as project progresses. Provide the ENGINEER with equipment for access and review of all Work in place, as well as personnel fully familiar with all aspects of the work. Provide access to all electrical components such as junction boxes, panelboards, switchboards, devices and fixtures for their review by the designer/ENGINEER.

D. Prior to start of Substantial Completion inspection, provide access to and prepare all electrical equipment and related components complete and ready for review by designer/ENGINEER including but not limited to the following:

1. All panelboard covers removed

2. Switchboard and distributions panelboards readily for immediate removal of covers

3. Terminal cabinet covers open or removed.

4. Wireway covers open or removed

5. Underground pull boxes ready for immediate removal of cover(s)

6. Access to all grounding/bonding terminations

7. Access to rated wall and through floor fire stopping

8. Access to all control systems for ALCMS (Airfield Lighting Control & Monitoring System).

9. Access to mechanical equipment, electrical connection points, and control devices

10. Access to all raceways crossing structural expansion/deflection joints.

11. Access to power company equipment

12. Removal of access panels

13. Each and every item deemed necessary by A/E to perform a comprehensive review of the work as installed relative to the contract documents.

E. Items noted after acceptance during one-year guarantee period shall be checked by the Contractor in the same manner as above. The signed reports are to be returned by him when the items have been corrected.

1.16 SYSTEMS WARRANTY

A. Reference the General Conditions.

B. Warranty shall be by the Contractor to the Owner and shall cover for a period of one year from the date of the Substantial Completion. Warranty shall not include light bulbs lamps in service after one month from date of substantial completion of the System.

1. Explain the provisions of warranty to the Owner at the "Demonstration of Completed System" meeting to be scheduled with the ENGINEER upon project completion.

C. Where items of equipment or materials carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material.

D. Where extended Guarantees are called for herein, furnish three copies to be inserted in Operation and Maintenance Manuals.

E. All preventative maintenance and normal service will be performed by the Owner's maintenance personnel after final acceptance of the work which shall not alter the Contractor's warranty.

1.17 WASTE MATERIALS DISPOSAL

A. Include in base bid the transport and disposal or recycling of all waste materials generated by this project in accordance with all rules, regulations and guidelines applicable. Comply fully with Florida Statute 403.7186 regarding mercury containing devices and lamps. Lamps, ballasts and other materials shall be transported and disposed of in accordance with all DEP and EPA guidelines applicable at time of disposal. Provide ENGINEER with written certification of approved disposal.

1.18 PROHIBITION OF ASBESTOS AND PCB

A. Prior to the Final Review field visit the Contractor shall certify in writing that the equipment and materials installed in this Project under this Division 26 contain no asbestos or PCB. Additionally, all manufacturers shall provide a statement with their submittal that indicates that their product contains no asbestos or PCB. This statement shall be signed by a duly authorized agent of the manufacturer. Existing oil filled current controlled regulators (CCR) that contain PCB shall be removed according to applicable regulations and Codes.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

## END OF SECTION 26 05 01

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# SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of Building Wire and Cable.

1.3 DESCRIPTION

A. Provide all equipment, labor, material, accessories, and mounting hardware to properly install all conductors and cables rated 600 volts and less for a complete and operating system for the following:

1. Building wire and cable.

2. Wiring connectors and connections.

B. No aluminum conductors shall be permitted.

C. All sizes shall be given in American Wire Gauge (AWG) or in thousand circular mils (MCM/KCMIL).

1.4 SUBMITTALS

A. Product Data: Submit catalog cut sheet showing, type and UL listing of each type of conductor, connector and termination.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of ANSI/NFPA 70.

1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Record actual routing on red lined as-builts.

E. Conductors with different voltages (i.e. 120 volt and 277 volt) shall not be combined in the same conduit without prior written approval from OAR and Engineer.

F. Conductors for each branch of power (Normal, Life safety, Critical, Security, and Equipment) shall be installed in its own dedicated raceway system.

1.8 COORDINATION

A. Determine required separation between cable and other work.

B. Coordinate cable routing to avoid interference with other work disciplines.

## PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THHN/THWN and XHHW.

E. Cable supports shall be O Z/Gedney Type “S” or approved substitution.

## PART 3 - EXECUTION

3.1 GENERAL

A. Install products in accordance with manufacturer’s instructions.

B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

C. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors. (As for multiple speed motors, different motor starter arrangements, etc.).

D. Conductors #12 AWG shall be 600 volt type THHN/THWN, solid unless specifically noted otherwise, rated 90 degrees C. dry.

E. Use conductor not smaller than 12 AWG for power and lighting circuits.

F. Provide dedicated neutral conductor for each branch phase conductor for 120V and 277V circuits (power and lighting). Multi-pole breakers to comply with NEC 210.4 are not permitted.

G. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (23 m).

H. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (61 m).

I. All conductors shall be installed in raceway.

J. Conductor sizes indicated on circuit homeruns or in schedules shall be installed over the entire length of the circuit unless noted otherwise on the drawings or in these specifications.

K. Coordinate all wire sizes with lug sizes on equipment, devices, etc. Provide/install lugs as required to match wire size.

L. Where oversized conductors are called for due to voltage drop, etc., provide/install lugs as required to match conductors, or provide/install splice box, and splice to reduce conductor size to match lug size.

3.2 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire has been completed.

3.3 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.4 WIRING METHODS

A. Use only building wire, Type THHN/THWN insulation, in raceway unless noted otherwise.

B. Wiring in vicinity of heat producing equipment: Use only XHHW insulation, in raceway.

C. Conductors installed within fluorescent fixture channels shall be Type THHN or XHHW, rated 90 degrees C dry. Conductors for all other light fixtures shall have temperature ratings as required to meet the UL listing of the fixture; however, in no case shall the temperature rating be less than 90 degrees Centigrade. Remove incorrect insulation types in new work.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 26 05 53 Identification for Electrical Systems.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

C. Identify neutrals with its associated circuit number(s) per NEC Article 210.4(D).

3.6 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of the General Requirements of the Contract Documents and Section 26 08 10 Tests and Performance Verification.

B. Inspect wire for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

E. Submit “Conductor Insulation Resistance Test” form as required in Section 26 08 10.

## 3.7 VERTICAL RISERS

A. Provide vertical cable riser supports per Article 300-19 in NFPA 70. These shall be located in accessible pullboxes of adequate size. Provide for adequate structural connection of cable supports to pullbox, which will transfer cable weight to building.

## 3.8 PULLING

A. No wire shall be pulled until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.

B. Mechanical pulling devices shall not be used on conductors sized #8 and smaller. Pulling means which might damage the raceway shall not be used.

C. Use only powdered soapstone or other pulling lubricant acceptable to the Designer/OAR. Compound or lubricant shall not cause the conductor or insulation to deteriorate.

D. All conductors to be installed in a common raceway shall be pulled together. The manufacturer's recommended pulling tensions shall not be exceeded.

E. Bending radius of insulated wire or cable shall not be less than the minimum recommended by the manufacturer.

F. Where coaxial type conductors are installed, special requirements shall apply as outlined under that specific system detail specifications.

G. Where control or signal circuits with a lower insulation rating enter an enclosure with conductors having a 600 volt or higher insulation rating, a separate wire way will be installed or proper clearance distance will be maintained per NEC.

H. All conductors shall be pulled in conduits by industry approved cable pulling “tuggers” equipment. The use of construction equipment such as fork lifts, tractors and other vehicles will not be allowed. All conductors will be routed and protected by using the proper pulleys and sheaves.

## 3.9 CONTROL AND SIGNAL CIRCUITS

A. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size, Type XHHW or THHN/THWN as permitted by NFPA 70, within voltage drop limits, increased to #12 AWG as necessary for proper operation.

B. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the contract documents.

C. Conductor insulation for fire alarm systems shall be as approved by Code Inspection Authority only. Wire approvals by the Designer/OAR shall not supersede this final approval for conditions of this specific project.

D. Install circuit conductors in conduit.

E. Circuit conductors #10AWG and larger to be stranded.

## 3.10 COLOR CODING

A. All power feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for a system throughout the building. Power feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape in all junction boxes and panels. Tape shall completely cover the full length of conductor insulation within the box or panel.

B. Unless otherwise approved or required by DESIGNER to match existing, color-code shall be as follows: Neutrals to be white for 120/208V system, natural grey for 277/480V system; ground wire green, bare or green, insulated ground conductor green with yellow tracer. 120/208V, Phase A - black; Phase B - red; Phase C - blue. 480/277V, Phase A brown; Phase B - orange; Phase C - yellow. All switch legs, other voltage system wiring, control and interlock wiring shall be color-coded other than those above.

3.11 TAPS/SPLICES/CONNECTORS/TERMINATIONS

A. Taps and splices are not acceptable unless specifically noted otherwise on drawings or special written approval is granted by Designer/OAR. (See 3.1K) Submit locations, sizes, etc., where taps will be necessary to coordinate with lug sizes/quantities for review and approval prior to installation.

B. Clean conductor surfaces before installing lugs and connectors.

C. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

D. Power and lighting conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wireways, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes (without special written approval of OAR).

E. Splices in lighting and power outlet boxes, wireway, and troughs shall be kept to a minimum, pull conductors through to equipment, terminal cabinets, and devices.

F. No splices shall be made in junction box, and outlet boxes (wire No. 8 and larger) without written approval of OAR.

G. No splices shall be made in communications outlet boxes, pull boxes or wireways (i.e., fire alarm, computer, telephone, intercom, sound system, etc.) without written approval of OAR. Pull cables through to equipment cabinets, terminal cabinets and devices.

H. No splices shall be made in circuits of #8 AWG conductors or larger of 1000 feet or less without written approval of the OAR.

I. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the providing by the Contractor of sleeve type vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.

J. A calibrated torque wrench shall be used for all bolt tightening. A torque mark should be used after torqueing is performed. Torque mark should consist of a permanent mark over the mechanical lug, bolt, nut, etc.

K. Interior Locations:

1. All (non-electronic systems) copper taps and splices in No. 8 or smaller shall be fastened together by means of "Screw-on spring type (wire nut)" connectors. All “Push-in” or “Stab-in” type connectors are prohibited. All taps and splices in wire larger than No. 8 shall be made with compression type connectors approved by OAR and taped to provide insulation equal to wire.

L. Exterior Locations:

1. Make splices, taps and terminations above grade in splice or termination cabinets. Do not splice any cable in ground or below finished grade.
2. All taps and splices shall be made with compression type connectors approved by OAR and covered with insulating material equivalent to conductor insulation or be terminated/connected to terminal strips in above grade terminal boxes suitable for use.
3. Provide and install above grade termination cabinets sized to meet applicable codes and standards, where required for splicing.

## END OF SECTION 26 05 19

# SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of grounding and bonding.

1.3 DESCRIPTION

A. Provide all labor, materials, and equipment necessary to properly install a grounding system conductor in all new branch wiring and feeder installations that shall be in full compliance with all applicable Codes as approved by the authorities having jurisdiction. The secondary distribution system shall include a grounding conductor in all raceways in addition to the return path of the metallic conduit.

B. In general, all electrical equipment (metallic conduit, motor frames, panelboards, etc.) shall be bonded together with a green insulated or bare copper system grounding conductor in accordance with specific rules of Article 250 of the N.E.C. and State codes. Bonding conductor through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panelboard, and from panel grounding bar of each panelboard to branch circuit equipment and devices.

C. All raceways shall have an insulated copper system ground conductor throughout the entire length of circuit installed with-in conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings. Grounding conductors run with feeders in PVC conduit outside of building(s) shall be bare only.

D. Section Includes

1. Grounding electrodes and conductors.

2. Equipment grounding conductors.

3. Bonding.

4. Ground Ring.

1.4 SUBMITTALS

A. Submit catalog cut sheet showing brand and selection for all conductors, test wells, components, etc., as specified herein showing that all materials are UL listed and labeled as applicable and manufactured in the United States.

B. Product data shall prove compliance with Contract Documents, National Electric Code, Underwriters Laboratories, manufacturer’s specifications, manufacturer’s written installation data and compliance with all performance criteria.

C. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

D. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

E. Show all dimensions, colors, configurations, covers and applicable labeling/stamping.

F. Record actual locations of grounding electrodes on red lined as-built documents.

G. Submit test results of each ground rod.

1.5 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to requirements of ANSI/NFPA 70 - National Electrical Code.

## PART 2 - PRODUCTS

2.1 ROD ELECTRODE

A. Material: Copper-clad steel.

B. Diameter: 5/8 inch.

C. Length: 20 feet minimum. Increase lengths as required to achieve specified resistance.

2.2 MECHANICAL CONNECTORS

A. All grounding connectors shall be in accordance with UL 467 and UL listed for use with rods, conductors, reinforcing bars, etc., as appropriate.

B. Connectors and devices used in the grounding systems shall be fabricated of copper or bronze materials, and properly applied for their intended use. Specified items of designated manufacturers indicate required criteria and equal products may be provided if approved. All connectors and devices shall be compatible with the surfaces being bonded and shall not cause galvanic corrosion by dissimilar metals. Materials in items not listed herein shall be of equal quality to the following specified items:

1. Lugs: substantial construction, of cast copper or cast bronze, with "ground" (micro-flat) surfaces equal to Burndy QQA-B Series, two hole, T&B, or approved substitution. Light weight and "competitive" devices shall be rejected.

2. Grounding and Bonding Bushings: Malleable iron, Thomas and Betts (T&B), or approved substitution.

3. Piping Clamps: Burndy "GAR-TC series" with two hole compression lug under U-Bolt nut, or T&B, or approved substitution.

4. Grounding Screw and Pigtail: Raco No. 983 or approved substitution.

5. Fastening hardware: Grade 5 silicone bronze with beveled washers. Copperplate is not acceptable

C. Mechanical lugs or wire terminals shall be used to bond ground wires together or to junction boxes and panel cabinets and shall be manufactured by Anderson, Buchanan, Thomas and Betts Co., or Burndy.

2.3 WIRE

A. Material: Stranded copper.

B. Size: Size to meet NFPA 70 requirements as a minimum, increase size if called for on drawings, in these specifications, or as required for voltage drop.

C. Insulated THWN (or bare as noted elsewhere).

2.4 GROUNDING WELL COMPONENTS

A. Grass Non-Traffic Areas:

1. Well: Minimum 12-inch long by 12-inch wide by 18 inches deep with open.

2. Well Cover: High density plastic, composolite, or cast iron with legend "GROUND" embossed on cover.

3. Material: Structural Plastic, composolite, or concrete.

4. Manufacturer: Brooks Products 70 Series or equal by Quazite or approved substitution.

5. Increase depth, diameter or size as required to provide proper access at installed location.

B. Paving and Low Traffic Areas:

1. Well: Minimum 12-inch long by 12-inch wide by 18 inches deep with open bottom.

2. Well Cover: Traffic rated for use with "GROUND" embossed on cover.

3. Material: Composolite.

4. Manufacturer: Quazite or approved substitution.

5. Increase depth, diameter or size as required to provide proper access at installed location.

2.5 GROUNDING BARS/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BARS AND GROUND BUS BARS)

A. Ground bars shall be copper of the size and description as shown on the drawings. If not sized on drawings, bus bar shall be minimum 1/4" x 2" bus grade copper, spaced from wall on insulating 2" polyester molded insulator standoff/supports, and be 12" or greater minimum overall length, allowing 2" length per lug connected thereto. Increase overall length as required to facilitate all lugs required while maintaining 2" spacing. Size of bus bar used in main electrical room shall be similar except minimum of 4" high and 24" long.

B. Provide bolt tapping lug with two hex head mounting bolts for each terminating ground conductor, sized to match conductors. Mount on bus bar at 2 inches on center spacing. Lugs to be manufactured by Burndy, T&B or approved substitution.

C. Bus bar shall have rows of holes in accordance with NEMA Standards for specified lugs.

D. Standoff supports to be 2" polyester as manufactured by Glastic #2015-4C or approved substitution.

## PART 3 - EXECUTION

3.1 GENERAL

A. Install products in accordance with manufacturer's instructions.

B. Install grounding electrodes conductor, bonding conductors, ground rods, etc. with all required accessories.

C. Grounding shall meet (or exceed as required to meet these specifications) all the requirements of the N.E.C., the NFPA, and applicable standards of IEEE.

D. Where there is a conflict between these specifications and the above applicable codes or standards, or between this section and other specifications sections then the most stringent or excessive requirement shall govern. Where there is an omission of a code/standard requirement in these specifications then the code/standard requirements shall be complied with.

E. Requirement in these specifications to comply with a specific code/standard article, etc. is not to be construed as deleting of requirements of other applicable codes/standards and their articles, etc.

F. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 GROUNDING ELECTRODES

A. All connections shall be exothermic welded unless otherwise noted herein. All connections above grade and in accessible locations may be by exothermic welding or by brasing or clamping with devices UL listed as suitable for use except in locations where exothermic welding is specifically specified in these specifications or called for on drawings.

B. Each rod shall be die stamped with identification of manufacturer and rod length.

C. Install rod electrodes at locations indicated and/or as called for in these specifications.

D. Ground Resistance:

1. Main Electrical Service (to each building and Site) and Generator Locations:

a) Grounding resistance measured at each main service electrode system and at each generator electrode system shall not exceed 5 ohms.

2. Lightning Protection Ground Locations:

a) Lightning Protection system ground locations shall not exceed 5 ohms measured at ground electrode.

3. Site Distribution Counterpoise Ground Locations:

a) Counterpoise system ground locations shall not exceed 25 ohms measured at ground electrode.

4. Other Locations:

a) Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, light poles, transformers, and other equipment.

5. Resistance called for above shall be maximum resistance of each ground electrode prior to connection to grounding electrode conductor. Where ground electrode system being measured consists of two (2) or more ground rod electrodes at each location, then the resistance specified above shall be the maximum resistance with two (2) or more rods connected together but not connected to the grounding electrode conductor.

E. Install additional rod electrodes as required to achieve specified resistance to ground (specified ground resistance is for each ground rod location prior to connection to ground electrode conductor).

F. Provide grounding well with cover at each rod location, with the only exception being a site distribution counterpoise ground rod. Install grounding well top flush with finished grade.

G. Install ground rods not less than 1 foot below grade level and not less than 2 feet from structure foundation.

3.3 GROUND RESISTANCE AT LOCATION OTHER THAN LOCATION OF GROUNDING ELECTRODES.

A. Resistance to ground of all non-current carrying metal parts shall not exceed 25 ohms measured at motors, panels, busses, cabinets, equipment racks, CCRs, transformers, and other equipment.

3.4 GROUNDING ELECTRODE CONDUCTOR

A. Conductor shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.66.

3.5 EQUIPMENT GROUNDING CONDUCTOR

A. Grounding conductors shall be provided with every circuit to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122.

B. At every voltage level, new portions of the electrical power distribution system shall be grounded with a dedicated copper conductor which extends from termination back to power source in supply panelboard.

C. Provide separate, insulated (bare if with feeder in PVC conduit ) conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

D. Except as otherwise indicated, each feeder raceway on the load side of the service entrance shall contain a ground conductor sized as indicated and where not shown shall be sized to meet (or exceed requirements of Contract Documents) the requirements of NEC 250.122. Conductor shall be connected to the equipment grounding bus in switchboards and panelboards, to the Grounding Bus in all motor control centers, and as specified, to lighting fixtures, motors and other types of

equipment and outlets. The ground shall be in addition to the metallic raceway and shall be connected, using a lug device located within each item enclosure at the point of electric power connections to permit convenient inspection.

E. Provide green insulated ground wire for all grounding type receptacles and for equipment of all voltages. In addition to grounding strap connection to metallic outlet boxes, a supplemental grounding wire and screw equal to Raco No. 983 shall be provided to connect receptacle ground terminal to the box.

F. All plugstrips and metallic surface raceway shall contain a green insulation ground conductor from supply panel ground bus connected to grounding screw on each receptacle in strip and to strip channel. Conductor shall be continuous.

G. Where integral grounding conductor is specified elsewhere in bus duct construction, provide equivalent capacity conductor from supply switchboard or panelboard grounding bus to the bus duct grounding conductor. Bond integral conductor to bus duct enclosure at each tap and each termination.

H. All motors, all heating coil assemblies, and all building equipment requiring flexible connections shall have a green grounding conductor properly connected to the frames and extending continuously inside conduit with circuit conductors to the supply source bus with approved connectors regardless of conduit size or type. This shall include "Equipment By Owner" to which an electric conduit is provided under this Division.

## 3.6 MAIN ELECTRICAL SERVICE

A. Complete installation shall meet or exceed the requirements of the NEC 250.

B. Artificial electrodes shall be provided for the main service in sufficient number and configuration to secure resistance specified.

C. Provide and bond to all of the following:

1. Ground rods.

2. Metal water pipe.

3. Building metal frame, structural steel or reinforced structural concrete.

4. Encased Electrodes.

5. Ground ring.

6. Site distribution counterpoise ground system.

7. Lightning protection system.

D. A main ground, bare copper conductor, sized per NEC Table 250.66, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to the building steel in respective building. This ground conductor shall also be run individually from the main switchgear and be bonded to the main water service ahead of any union in pipe and must be metal pipe of length and location as acceptable by authorities having jurisdiction. Provide properly sized

bonding shunt around water meter and/or dielectric unions in the water pipe. Also required is the same size ground wire to ground rod electrode as called for below:

1. Three 20 ft. ground rods in a delta configuration at no less than 20 ft. spacing driven to a minimum depth of 20 feet, one foot below grade.

2. Bond ground rod electrodes together with a bare copper ground conductor that matches size required by NEC Table 250.66, but in no case less than #2/0.

3. Provide additional rod electrodes as required to achieve specified ground resistance.

E. Ground/bond neutral per NEC 250.

F. A main ground, bare copper conductor, sized per applicable Table in NEC 250, but in no case less than #2/0, shall be run in conduit from the main switchgear of each building to a concrete encased electrode per NEC 250.52(3).

G. Bond grounding electrodes to site counterpoise grounding system and lightning protection system where provided.

H. Provide and install ground bus bar on wall near main service disconnect/switchboard. Connect to ground bar in disconnect/switchboard bonded to switchboard/disconnect enclosure/neutral with copper grounding conductor sized per NEC Table 250.66.

## 3.7 TRANSFORMER GROUNDING

A. Ground all transformers and enclosures of 120/208V and 277/480V "separately derived systems" as specified herein.

1. Ground per NEC 250 and these specifications.

2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per NEC Table 250.66.

3. Connect transformer neutral/ground to grounding electrode per NEC 250.30 with grounding electrode conductor sized per NEC Table 250.66.

4. In addition to connection to grounding electrode conductor called for above, provide supplemental grounding electrode as follows:

a) Where grounding required per NEC 250.30 is to building steel/structure, supplement this grounding with connection to nearest available effectively grounded metal water pipe.

b) Where grounding connection required per NEC 250.30 is to grounded metal water pipe, supplement with connection to building steel/structure in addition to any other available electrodes specified in NEC 250.50 and 250.52.

c) Where supplemental grounding electrodes required above is a ground rod electrode, provide two or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven full length into the earth one foot below grade.

5. Where neither building steel nor water pipe grounding electrodes are available (i.e. exterior locations with no available water pipe electrode) provide two (2) ground

connections: each 20 ft. ground rod electrodes at not less than 20 ft. spacing, driven full length into the earth one foot below grade.

6. Where transformer is mounted to exterior of building, one (1) of the two (2) ground electrodes required shall be ground rod electrode as called for in 5. above. This ground rod electrode shall also be connected to counterpoise system.

B. Provide additional ground electrodes as required to achieve specified ground resistance.

C. Where two or more ground electrodes are used at any required ground location, they shall be bonded together with a copper ground conductor, sized to meet NEC Table 250.66, but in no case less than #2/0.

D. Complete installation shall meet or exceed the minimum requirements of NEC 250.

E. Equipment ground conductors shall be provided in addition to above grounding. See 'EQUIPMENT GROUNDING CONDUCTOR', NEC 250.122.

F. Provide ground bus bar on wall near transformer (or in associated electrical room for exterior mounted transformers). Connect to ground lug in transformer bonded to transformer enclosure/neutral with copper ground conductor sized per NEC Table 250.66.

G. Multiple separately derived systems may be grounded as allowed in NEC 250-30(A)(4).

3.8 GENERATOR GROUNDING

A. Separately derived systems (i.e. systems where generator neutral is not solidly interconnected to service supplied system neutral such as 4 pole switched neutral transfer switch systems).

1. Ground per NEC 250.20, 250.30, 250.66 and these specifications.

2. Bond neutral to transformer frame/enclosure and the equipment grounding conductors of the derived system with copper ground conductor sized per NEC Table 250.66.

3. Connect generator neutral/ground to grounding electrodes per NEC 250.30 with grounding electrode conductor sized per NEC Table 250.66.

4. In addition, provide supplemental grounding electrode as follows:

a) Where grounding required per NEC 250.30 is to building steel/structure, supplement with connection to nearest available effectively grounded metal water pipe.

b) Where grounding connection required per NEC 250.30 is to grounded metal water pipe, grounding with connection to other electrodes specified in NEC 250.50 and 250.52.

c) Where supplemental grounding electrode required above is a ground rod electrode, provide two or more 30 ft. ground rod electrodes at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 foot below grade.

5. Where neither building steel nor water pipe grounding electrodes are available provide two (2) ground connections: each to two (2) or more 20 ft. ground rod electrodes at no less than 20 ft. spacing, driven vertical to a minimum depth of 20 ft. plus 1 foot below grade.

6. Where generator is mounted to exterior of building, one (1) of the two (2) ground electrodes required shall be ground rod electrode as called for in Paragraph 3.8 A.5. This ground rod electrode shall also be connected to counterpoise system.

B. Provide additional ground electrodes as required to achieve specified ground resistance.

C. Where two or more ground electrodes are used at any one required ground location, they shall be bonded together with a copper ground conductor, sized to meet NEC Table 250.66, but in no case less than #2/0.

D. Complete installation shall meet or exceed the minimum requirements of NEC 250.

E. Equipment ground conductors shall be provided in addition to above grounding. See 'EQUIPMENT GROUNDING CONDUCTOR'.

3.9 LIGHTNING PROTECTION SYSTEMS

A. Ground per Section 26 41 13 – Lightning Protection for Structures, NFPA 780, and as specified herein. The most stringent requirements shall govern.

B. Bond lightning protection system grounds to electrical service system ground, and counterpoise system ground where provided.

3.10 EXTERIOR GRADE (OR FREE STANDING ABOVE GROUND) MOUNTED EQUIPMENT

A. General:

1. All equipment mounted exterior to building shall have their enclosures grounded directly to a grounding electrode at the equipment location in addition to the building equipment ground connection.

2. Bond each equipment enclosure, metal rack support, mounting channels, etc. to ground electrode system at each rack with an insulated copper ground conductor sized to match the grounding electrode conductor required by NEC Table 250.66 based on equipment feeder size, but in no case shall conductor be smaller than #6 copper or larger than #2 copper. This connection is in addition to grounding electrode connections required for services.

B. Main electrical service rack mounted equipment.

1. Ground per "MAIN ELECTRICAL SERVICE".

2. Bond all metal parts as noted in this section.

C. Electrical sub service rack mounted equipment.

1. Ground per "MAIN ELECTRICAL SERVICE", except do not bond neutral to ground.

2. Bond all metal parts as noted in this section.

D. Electrical equipment connection rack mounted equipment.

1. Bond all metal parts as noted in this section.

E. Grounding electrodes (ground electrodes system) shall be:

1. Located at each rack location.

2. For service equipment: Ground electrode required per "MAIN ELECTRICAL SERVICE".

3. For equipment connection: Two or more 30 ft. ground rods at no less than 30 ft. spacing, driven vertical to a minimum depth of 30 ft. plus 1 ft. below grade. Bond ground rods together with a size to meet NEC Table 250.66, but no less than a #2 copper ground conductor. Provide additional rod electrodes as required to achieve specified ground resistance.

F. Complete installation shall meet or exceed the minimum requirements of NEC 250 and, when applicable, NFPA 78.

3.11 ROOF MOUNTED EQUIPMENT

A. Bond all roof mounted electrical equipment to lightning protection system (when provided) per NFPA 780.

3.12 LIGHTING FIXTURES

A. All new and reinstalled fixtures shall be provided with green grounding conductor, solidly connected to unit. Individual fixtures grounds shall be with lug to fixture body, locate at point of electrical connection to the fixture unit.

B. All suspended fixtures and those supplied through flexible metallic conduit shall have green ground conductor from outlet box to fixture. Cord connected fixtures shall contain a separate green ground conductor.

3.13 PULLBOX, MANHOLE, HANDHOLE GROUNDING.

A. One 30 ft. ground rod electrode shall be driven vertically to a minimum depth of 30 ft. plus 1 ft. below grade in each manhole, handhole or pullbox (in ground).

B. The complete installation shall exceed the minimum requirements of the NEC.

C. Provide additional ground rod electrodes as required to provide resistance called for herein.

D. Bond grounding electrode to all exposed metal parts of manhole, handhole, pullbox (including metal cover) with #6 copper ground conductor. Connect to ground rod electrode with exothermic weld. Connect to metal cover with exothermic weld. Connect to other metal parts with exothermic weld or UL approved grounding clamp. Provide minimum 3 ft. slack ground cable on cover connection to facilitate removal of cover.

3.14 HAZARDOUS LOCATIONS

A. Grounding in hazardous locations shall be done in accordance with applicable portions of Articles 500, 501, 502, 503, 511 and 514 of the National Electrical Code.

3.15 GROUND RING

A. Provide complete underground building perimeter ground ring system, completely encircling building.

B. Install minimum 2-1/2 feet depth into earth.

C. Install ground rods (minimum 20 ft. long) every 150 feet section of ground ring conductor.

D. Bond ground ring to building steel every 150 feet of building perimeter, bond to any and all electrical and piping systems that cross the ground ring system, bond to lightning protection down conductors and to any lightning or other earth grounding electrodes that may be present on the premises.

E. Bond to building service.

3.16 MISCELLANEOUS GROUNDING CONNECTIONS

A. Provide bonding to meet regulatory requirements.

B. Required connections to building steel shall be with UL approved non-reversible crimp type ground lugs exothermically welded to bus bar that is either exothermically welded to steel or bolted to steel in locations where weld will affect the structural properties of the steel.

C. Install grounding conductors to permit shortest and most direct path from equipment to ground; install in conduit; bond to conduit at both ends when conduit is metal; have connections accessible for inspection; and made with approved solderless connectors brazed (or bolted) to the equipment ground; in NO case be a current carrying conductor; have a green jacket unless it is bare copper; be run in conduit with power and branch circuit conductors. The main grounding electrodes conductor shall be exothermically welded to ground rods, water pipe, and building steel.

D. All surfaces to which grounding connections are made shall be thoroughly cleaned to maximum conductive condition immediately before connections are made thereto. Metal rustproofing shall be removed at grounding contact surfaces, for 0 ohms by digital Vm. Exposed bare metal at the termination point shall be painted.

E. All ground connections that are buried or in otherwise inaccessible locations, shall be welded exothermically. The weld shall provide a connection which shall not corrode or loosen and which shall be equal or larger in size than the conductors joined together. The connection shall have the same current carrying capacity as the largest conductor.

F. Install ground bushings on all metal conduits entering enclosures where the continuity of grounding is broken between the conduit and enclosure (i.e. metal conduit stub-up into a motor control center enclosure or at ground bus bar). Provide an appropriately sized bond jumper from the ground bushing to the respective equipment ground bus or ground bus bar.

G. Each feeder metallic conduit shall be bonded at all discontinuities, including at switchboards and all subdistribution and branch circuit panels with conductors in accordance with Table 250.122 of NEC for parallel return with respective interior grounding conductor.

H. Grounding provisions shall include double locknuts on all heavywall conduits.

I. Install grounding bus in all existing panelboards of remodeled areas, for connection of new grounding conductors, connected to an approved ground point.

J. Bond together reinforcing steel and metal accessories in pool and fountain structures and bond to electrical system per NEC.

K. Where reinforced concrete is utilized for building grounding system, proper reinforced bonding shall be provided to secure low resistance to earth with "thermite" type devices, and #10AWG wire ties shall be provided to not less than ten (10) full length rebars which contact the connected rebar. Provide size and length of rod to meet NEC requirements.

3.17 GROUNDING BAR/GROUND BUS (INCLUDING 'SYSTEMS' GROUND BUS/BAR ON GROUND BUS/BAR) INSTALLATION

A. Where indicated on the drawings, provide grounding bar/ground bus (bus bar). Metal sheaths of underground cables are also to be grounded thereto at points of building entrance.

B. Mount bolt tapping lugs with hex head bolts to bus bar at 2" o.c. spacing, one for each ground conductor.

C. Mount bus bar to wall using 2" polyester molded insulator stand-off.

D. Extend a #2/0 (minimum size) or larger THWN insulated copper ground conductor (if larger size is called for on drawings or required by N.E.C. for service ground, etc.) in PVC conduit to approved service ground installation or ground bus/bar in main service equipment enclosure.

E. Extend #6 insulated copper ground wire from respective bus/bar to each 'local' ground bus/bar in each cabinet for system.

F. 'SYSTEMS' grounding bus/bar must be connected with #2/0 insulated copper conductor to grounding electrodes system as defined in NEC "Article 800-40(b).

3.18 TESTING AND REPORTS

A. Raceway Continuity: Metallic raceway system as a component of the facilities ground system shall be tested for electrical continuity. Resistance to ground throughout the system shall not exceed specified limits.

B. Ground resistance measurements shall be made on each system utilized including:

1. Building structural steel.

2. Driven grounding system.

3. Water pipe grounding system.

4. Other approved systems.

C. Ground resistance measurements shall be made in normally dry weather, not less than 24 hours after rainfall, and with the ground under test isolated from other grounds and equipment. Resistances measured shall not exceed specified limits.

D. Upon completion of testing, the testing conditions and results shall be certified by the Contractor and submitted to the Designer as called for in Section 26 00 90 - Test and Performance Verification.

3.19 INTERFACE WITH OTHER PRODUCTS

A. Interface with site grounding system.

B. Interface with lightning protection system installed under Section 26 41 13.

3.20 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Use suitable test instruments to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method.

## END OF SECTION 26 05 26

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# SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of supporting devices.

1.3 DESCRIPTION

A. Furnish and install all supports, anchors, fasteners, hangers and inserts required to mount fixtures, conduit, cables, pullboxes and other equipment furnished under this Division.

1.4 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. NECA - National Electrical Contractors Association.

2. ANSI/NFPA 70 - National Electrical Code.

1.5 SUBMITTALS

A. Submit catalog cut sheet showing brand of conduit supporting hardware to be used and (where applicable) showing that conduit supporting hardware is UL listed and labeled, and manufactured in the United States.

B. Submit catalog cut sheet on all types of conduit support fittings, hardware, straps, and hangers.

C. Product data shall be submitted for approval on:

1. Mounting hardware and inserts.

2. Conduit straps, hangers and fittings.

3. Supporting channel.

D. Product data shall prove compliance with Contract Documents, National Electric Code, National Board of Fire Underwriters, manufacturer's specifications and written installation data.

E. Submit shop drawing showing routing and location of all conduit racking systems. Provide coordination drawings.

## PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide corrosion resistance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation."

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Do not use spring steel clips and clamps and metal banding straps.

E. Do not fasten supports to sides or bottom of pre-cast structural beams.

F. Obtain permission from OAR before drilling, or cutting structural members.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use stainless steel channel supports to stand cabinets and panelboards one inch (25) mm) off wall.

J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

K. All items shall be supported from the structural portion of the building, except standard ceiling-mounted lighting fixtures. Small devices may be supported from ceiling system where permitted by ceiling system manufacturer, however, no sagging of the ceiling will be permitted. Wire shall not be used as a support. Boxes and conduit shall not be supported or fastened to ceiling suspension wires or to ceiling channels.

L. Lay out and install work in advance of the laying of floors or walls, and provide all sleeves that may be required for openings through floors, walls, or other assemblies. Where plans call for conduit to be run exposed, provide all inserts and clamps for the supporting of conduit.

M. All conduits shall be securely fastened in place on maximum of 8 foot intervals. Hangers, supports or fastenings shall be provided at each elbow and at the end of each straight run terminating at a box or cabinet. The use of perforated iron for supporting conduits will not be permitted. The required strength of the supporting equipment and size and type of anchors shall be based on the combined weight of conduit, hanger and cables. Horizontal and vertical conduit runs may be supported by one-hole malleable straps, clamp-backs, or other approved devices with suitable bolts, expansion shields (where needed) or beam-clamps for mounting to building structure or

special brackets.

N. Where two or more conduits are ran parallel or in a similar direction, they shall be grouped together and supported by means of 1½" x 1½", 12 gauge, pre-galvanized zinc (B-Line or approved substitution), conduit channel trapeze hanger system (racking) consisting of concrete inserts, threaded rods, washers, double nuts for each rod, locknut washers and galvanized "L" angle iron, or Unistrut cross members. Where galvanized "L" angle iron is used, conduits shall be individually fastened to the cross members with malleable iron hangers listed and approved for use on "L" angle iron, bolted with proper size cadmium machine bolts, washers and nuts. Conduits supported to unistrut channel shall be individually fastened with two piece unistrut straps with bolts and nuts listed and approved for such use. Mineralak hangers or one hole type straps fastened to Kindorf racking is not acceptable. Beam clamps shall be malleable iron. All single panelboard, switchboard and motor control center feeder raceway runs shall be supported by means of a trapeze channel hanger support system with provisions for future as specified.

O. All hangers and mounting hardware clamps shall be made of durable material suitable for the application involved. Where excessive corrosive conditions or exterior and damp conditions are encountered, hanger assemblies shall be malleable iron or protected after fabrication by hot dipped galvanizing and where written approval is authorized by the OAR, special paint or other suitable preservative methods may be used.

P. On concrete or brick construction, an electric or hand drill shall be used for drilling holes for all inserts in brick, concrete or similar construction. In brick, inserts shall be near center of brick, not near edge or in joint. Where steel members occur, same shall be drilled and tapped, and round head machine screws shall be used. All screws, bolts and washers used for supporting conduit or outlets shall be fabricated from rust-resisting metal. Self-tapping power driven fasteners are acceptable on block or brick construction only. Plastic anchors are not acceptable.

Q. Spring type conduit clip devices are not acceptable for conduit support.

R. Threaded rod hangers shall be galvanized continuous thread type, minimum 3/8" diameter. Increase size as required to support assembly. Bending of rod hangers is not permitted.

S. Concrete anchors, thread rods, or similar fasteners installed on side or bottom of pre-stressed beams are not acceptable.

T. Group related conduits; support using conduit rack. Construct rack using steel channel in dry locations and galvanized channel or aluminum channel in damp or wet locations (minimum of 24", increase, distance as required for quantity of conduits and spare capacity) provide space on each rack for Building Automation Systems (BAS) raceways and 25 percent additional conduits. Group conduits on channel racking adjacent to each other at one side, allowing all remaining unused space as spare capacity. Spacing between conduits shall not exceed 1" unless written permission is granted by OAR.

U. Each rack shall be provided with minimum of two (2) threaded rod hangers located at the ends of the channel. Increase number of hangers as required to support the assembly.

V. Rack Mounted Equipment: Use channel support system for all rack mounted equipment including all free standing rack mounted equipment. Exterior rack support system to be stainless steel channel. See details on drawings where available. Exterior units shall be thoroughly inspected after installation.

## END OF SECTION 26 05 29

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# SECTION 26 05 33.13 – CONDUIT FOR ELECTRCIAL SYSTEMS

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of conduit for electrical systems.

1.3 DESCRIPTION

A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:

1. Rigid Metallic Conduit (RMC)

2. PVC coated Metal Conduit.

3. Flexible metal conduit (FMC)

4. Liquidtight flexible metal conduit (LFMC)

5. Electrical metallic tubing (EMT)

6. Rigid non-metallic conduit (PVC) (RNC)

7. Fittings and conduit bodies.

B. Raceways and conduits shall begin at an acceptable enclosure and terminate only in another such enclosure except conduit/raceway stub-outs.

C. A raceway shall be provided for all electrical power, lighting and electrical systems.

D. Where the Contract Documents refer to the terms "raceway," or "conduit" the materials shall be as listed above in conjunction with NEC article 100, definition of "raceway". MC and HCF flexible metal cables shall not be considered a substitute for raceway or conduit.

1.4 SUBMITTALS

A. Submit catalog cut sheet showing brand of conduit to be used and showing that conduit is UL listed and labeled, and manufactured in the United States.

B. Submit catalog cut sheet on all types of conduit bodies, and fittings.

C. Submit product data on:

1. Conduits.

2. Conduit straps, hangers and fittings.

3. PVC solvent(s) and bending box.

4. Fitting entering and leaving the ground or pavement.

5. Cables

6. Expansion/deflection fittings.

D. Submit UL listed fire and smoke stopping assemblies for each applicable application. Provide details from UL Fire Directory and manufacturers' corresponding product data and details.

E. Product data shall prove compliance with Specifications, National Electrical Code, National Board of Fire Underwriters, manufacturer's specifications and written installation data.

1.5 PROJECT AS-BUILT DOCUMENTS

A. As-built documents shall accurately record actual routing of conduits.

1.6 REFERENCE AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the following:

1. NFPA 70 - National Electrical Code (NEC).

2. ANSI C80.1 - Electrical Rigid Steel Conduit (ERSC).

3. ANSI C80.3 - Electrical Metallic Tubing (EMT).

4. ANSI/UL 651 - Rigid Non Metallic Conduit (PVC)

5. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing (EMT) and Cable.

6. NECA "Standard of Installation."

7. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).

8. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

9. ANSI/Fed. Spec. J-C-30B - Flexible Metal Cables, Galvanized steel jacket.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.8 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

**PART 2 - PRODUCTS**

2.1 GENERAL

A. All conduits shall bear UL label (or other nationally recognized testing agency).

B. Conduit systems and all related fittings, boxes, supports, and hangers must meet all the requirements of national, state, requirements and all related FAA codes and other Federal codes where applicable.

2.2 MINIMUM TRADE SIZE

A. Power/Lighting Homeruns 3/4”

B. Power/Lighting Branch Circuits Between Devices 1/2”

C. Systems Conduit 1”

D. Flexible and Seal-tite metallic conduit – 1/2”C (maximum 6 ft. long).

2.3 RIGID METAL CONDUIT

A. Comply with:

1. ANSI C80.1
2. UL 6
3. NEC
4. Fed. Specification WW-C-581e.

B. Conduit material:

1. Hot-dipped galvanized steel.

C. Fittings:

1. Threaded.
2. Insulated bushings shall be used on all rigid metal conduits terminating in panels, boxes, wire gutters, or cabinets, and shall be impact resistant plastic molded in an irregular shape at the top to provide smooth insulating surface at top and inner edge. Material in these bushings must not melt or support flame.
3. Hot-dipped galvanized malleable iron or steel manufactured in accord with ANSI C80.4.

D. Conduit Bodies:

1. Comply with ANSI/NEMA FB 1.
2. Threaded hubs.

3. Hot-dipped galvanized malleable iron.

2.4 PVC COATED METAL CONDUIT

A. Comply with:

1. UL6
2. ANSI C80.1
3. NEC
4. NEMA RN1
5. Fed. Specification WW-C-581E.

B. Conduit material: Hot-dipped galvanized rigid steel with external PVC coating, 20 mil. thick.

C. Fittings:

1. Threaded.
2. Insulated bushings on terminations.
3. Hot-dipped galvanized malleable iron or steel with external PVC coating, 20 mil. thick.

D. Conduit bodies:

1. Comply with:

a) ANSI/NEMA FB 1
b) Threaded hubs
c) Hot-dipped galvanized malleable iron.

2.5 FLEXIBLE METAL CONDUIT

A. Comply with:

1. NEC
2. ANSI/UL 1
3. Fed. Specification WW-C-566

B. Conduit material: Hot-dip galvanized Steel, interlocked.

C. Fittings:

1. ANSI/NEMA FB 1
2. ANSI/UL 514B
3. Malleable iron, zinc plated.
4. Direct flexible conduit bearing set screw type not acceptable.
5. Insulated throat on terminations.
6. Compression EMT to flexible conduit coupling is not acceptable unless special written permission is grated by OAR.
7. Comply also with Fed. Specification W-F-406

2.6 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

A. Comply with:

1. NEC
2. ANSI/UL 360

B. Conduit material:

1. Flexible hot-dipped galvanized steel core, interlocked.
2. Continuous copper ground, built into core up to 1-1/4" size.
3. Extruded polyvinyl gray jacket.

C. Fittings:

1. Threaded for IMC/rigid conduit connections.
2. Approved for hazardous locations where so installed.
3. Provide sealing washer in wet/damp locations.
4. Compression type.
5. ANSI/NEMA FB 1.
6. ANSI/UL 5148.
7. Hot-dipped galvanized malleable iron or steel.
8. Insulated throat on terminations.
9. Comply with Fed. Specification W-F-406.
10. Connections to vibrating equipment and transformers.

a) Connectors to have wire mesh conduit grip.

2.7 ELECTRICAL METAL CONDUIT

A. Comply with:

1. U.L 797
2. ANSI C80.3
3. NEC
4. ANSI/UL797
5. Fed. Specification WWC-563

B. Conduit material: Hot-dip Galvanized steel tubing (Electrogalvanized zinc is not acceptable).

C. Fittings:

1. ANSI/NEMA FB 1
2. Compression type.
3. Insulated throat on terminations.
4. Hot-dipped galvanized malleable iron or steel.
5. Fed. Specification W-F-408.

2.8 RIGID NON-METALLIC CONDUIT (PVC)

A. Comply with:

1. NEMA TC-2
2. UL 651
3. NEC
4. Fed. Specification WC1094A.

B. Conduit material:

1. Shall be high impact P.V.C. - tensile strength 55 PSI, flexural strength 11000 PSI.

C. Fittings:

1. Comply with: NEMA TC-3 and UL 514.

D. General:

1. Shall be UL listed.
2. Fittings and elbows shall be by the same manufacture as conduit.

2.9 EXPANSION FITTINGS

A. Expansion/deflection fittings shall be:

1. Listed, hot dipped galvanized inside and outside providing a 4" expansion chamber and deflection (where applicable) when used with rigid conduit, intermediate metal conduit and electrical metallic conduit, or:
2. U.L. Listed, polyvinyl chloride providing a minimum 6” expansion chamber when used with non-metallic conduit (PVC), and shall meet the requirements of and as specified elsewhere for non-metallic conduit. Provide fittings as specified above for expansion/deflection conditions.
3. Hot dipped galvanized expansion and deflection (where applicable) fitting shall be provided with an external braided grounding and bonding jumper with approved clamps, UL Listed for the application.
4. Expansion fitting, UL Listed for the application and in compliance with the National Electrical Code without the necessity of an external bonding jumper may be considered. Submit fitting with manufacturer's data and UL Listing for approval prior to installation.

**PART 3 - EXECUTION**

3.1 LOCATION REQUIREMENTS

A. Underground Installations:

1. Use Schedule 40 thickwall nonmetallic conduit only unless local authority having jurisdiction or applicable codes/utility requirements, etc. require rigid steel conduit.
2. Encase conduit in a concrete envelope of not less than 3” thickness on all sides and not less than 1-1/2” between conduits (where more than one conduit is installed together) for:

   a) All conduits installed under roads, taxiways, and runways.
   b) All conduits installed for primary electric circuits, main feeders, and data/communications systems (i.e. Telephone, data, parking revenue, radio, flight information, air traffic control systems, security, fiber optic).

3. All conduits or elbows entering or leaving any slab or the ground shall be rigid steel conduit coated with asphalt paint.
4. Where rigid metallic conduit is installed underground as noted above it shall be coated with waterproofing black mastic before installation, and all joints shall be re-coated after installation.
5. All PVC runs over 100 ft. in length shall utilize rigid steel 90° elbows at each horizontal change in direction. All PVC risers shall utilize rigid steel 90° elbows. Elbows shall be coated with black mastic or PVC coating. Bond all metal elbows per NEC.
6. Underground raceway systems shall conform to all national, state, local and FAA regulations, in general and Article 300, Section 300.5 of the National Electrical Code specifically.

   a) Depth of conduits shall be not less than 18" with the following exceptions:

1) Conduits installed in concrete floors of buildings to have a minimum concrete cover not less than 2".
2) Conduits passing under taxiways, runways, ramps, holding areas, and docking areas, must be installed below the concrete pour, in the sub base, and shall be encased in not less than 3" of concrete, the specifications of which shall meet the same standards required for runways and taxiways except that slump shall be 3 to 4 inches.

7. Verify finished lines in areas where raceways will be installed underground before the grading is complete.

B. In Slab, Above or On Grade:

1. Use coated rigid steel conduit, coated intermediate metal conduit (if approved) or thickwall nonmetallic conduit.
2. In slab conduit is permitted only where written consent is granted by Architect and Structural Engineer, regardless of that shown or noted by drawings. Install as directed by Architect/Structural Engineer.

C. Penetration of Slab:

1. Exposed Location:

a) Where penetrating a floor in an exposed location from underground or in slab, a black coated galvanized rigid steel conduit shall be used.

2. Concealed Location:

a) Where penetrating a floor in a location concealed in block wall and acceptable by applicable codes, non-metallic conduit may be used up to first outlet box, provided outlet box is at a maximum height of 40" above finished floor.
b) Where penetrating a floor from underground or in slab, a coated galvanized rigid steel conduit shall be used.

D. Outdoor Location:

1. Above Grade:

a) Where penetrating the finished grade, a coated galvanized rigid steel conduit shall be used.
b) All exterior conduit runs shall be rigid conduit and threaded connectors as specified elsewhere.
c) All areas subject to exterior conditions such as overhangs, galvanized rigid steel conduit shall be used.

2. Roofs:

a) Conduit is not to be installed on roofs, without written authorization by OAR for specific conditions.
b) When approved by written authorization conduit shall comply with the following:

1) Be PVC coated rigid galvanized metal conduit.
2) All fittings, etc. are to be PVC coated.

3) Conduit shall be supported above roof at least 6 inches using approved conduit supporting devices. Refer to applicable roofing specifications.
4) Fasten supports to roof per roofing manufacturer's recommendations.

E. Interior Dry Locations:

1. Concealed:

a) Use rigid galvanized steel and electrical metallic tubing. Thickwall non-metallic conduit (PVC) may be used inside block walls up to first outlet to a maximum of 40" A.F.F. except where prohibited by the NEC.

2. Exposed:

a) Use rigid galvanized steel and electrical metallic tubing. EMT may only be used where not subject to damage which is interpreted by this specification to be above 96" AFF and exiting the top of panelboards, terminal cabinets, and control panels.

3. Concealed or exposed flexible conduit:

a) Concealed: Flexible steel conduit or seal tight flexible steel conduit shall be in lengths not longer than six (6) feet in length with a ground conductor firmly attached to the terminating fitting at the extreme end of the flex. Direct change over from conduit to flexible conduit is not acceptable unless written permission is granted by OAR or specifically noted on drawings.
b) Exposed: Liquid tight flexible steel conduit shall be used for connections to motors, movable equipment, or vibration equipment (transformers, pumps, AHU's, loading bridges, etc.) as specified herein. Lengths shall not exceed four (4) feet in length unless written authorization by OAR for specific conduits is granted. Connections to vibration equipment, motors, etc shall be made with wire mesh grip fittings as specified herein. Flexible steel conduit is not acceptable in exposed locations. All exposed flexible metal conduit shall be liquid tight.

F. Interior Wet and Damp Locations:

1. Use rigid galvanized steel in interior wet and damp locations. Areas which are subject to direct exterior conditions such as parking garages and open ramp overhangs shall be classified "WET/EXTERIOR LOCATION."

G. Concrete Columns or Poured in-place Concrete Wall Locations:

1. Use thickwall non-metallic conduit. Penetration shall be by approved metal raceway (i.e. metal conduit as required elsewhere in these specifications).

H. Corrosive Locations:

1. Comply with all codes and standards.

3.2 ADDITIONAL REQUIREMENTS FOR RIGID METAL STEEL CONDUIT

A. Rigid metal conduit shall be cut and threaded with tools approved for the purpose and by qualified personnel.

1. Approved pipe vise.
2. Roller/bade type cutter or band saw.
3. Reamer capable of completely removing al ridges or burrs left by the cutter. Reaming with pliers is not acceptable.

B. Hangers shall be installed 8 ft. apart.

C. Conduits stubbed through floor slabs, above grade and not contained inside walls, shall be rigid galvanized metallic conduit.

D. One hole pipe straps shall be malleable iron. Wet location applications shall include malleable iron back clamp spacers.

E. Use of two piece threaded union fittings and rigid set screw fittings are not permitted. Threaded unions may be acceptable where required for special field conditions only when special written permission is granted by OAR.

3.1 ADDITIONAL REQUIREMENTS FOR INTERMEDIATE METAL CONDUIT (IMC)

A. May be installed only by special written permission.

B. If written approval is received then IMC may be used in locations acceptable by NEC and elsewhere in these specifications, whichever is most stringent.

3.3 ADDITIONAL REQUIREMENTS FOR FLEXIBLE STEEL CONDUIT AND LIQUID-TITE FLEXIBLE METAL CONDUIT

A. Shall be properly grounded.

B. Shall be installed with approved fittings.

C. Shall be used for final connections to vibrating equipment such as motors, pumps, transformers, etc.

D. Liquid-tight conduit termination connectors at vibration equipment (i.e. pumps, AHU’s, motors, moveable equipment, etc) shall be provided with wire mesh grips.

3.4 ADDITIONAL REQUIREMENTS FOR NON METALLIC CONDUIT (PVC)

A. PVC conduit is not allowed anywhere inside building(s) except underground, in slab, in poured in place concrete, and in block wall up to first outlet box (if not over 40" AFF) if allowed by codes. In elevated slabs, conduit is permitted only where written consent is granted by Structural Engineer, regardless of that shown or noted by drawings. Install as directed by Architect/Structural Engineer.

B. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

C. Threads will not be permitted on PVC conduit and fittings, except for rigid steel to PVC couplings.

D. Installation of PVC conduit shall be in accordance with manufacturer's recommendations.

E. PVC conduit shall not be used to support fixture or equipment.

F. Field bends or direction changes shall be by manufactured bends only. Heating with flame and hand held dryers are prohibited.

G. PVC fittings and elbows shall be by same manufacture as conduit.

3.5 ADDITIONAL REQUIREMENTS FOR PVC COATED CONDUIT

A. All cuts, pinholes and ends shall be sealed using liquid PVC patch. PVC coated conduit shall be thoroughly inspected after installation to assure all voids, cuts, pinholes or other violation of the integrity of the PVC coating are sealed.

3.6 SUPPORTS

A. Comply with the requirements of Section 26 05 29 Hangers and Supports for Electrical Systems.

B. Arrange supports to prevent misalignment during wiring installation.

3.7 EXPANSION/DEFLECTION FITTINGS

A. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.

B. Expansion fittings shall be installed in the following cases:

1. In each conduit run wherever it crosses an expansion joint in the concrete structure.
2. On one side of joint with its sliding sleeve end flush with joint, and with a length of bonding jumper in expansion/deflection equal to at least three times the normal width of joints.
3. In each conduit run which mechanically attaches to separate structures to relieve strain caused by shift on one structure in relation to the other.
4. In straight conduit run above ground that is more than one hundred feet long and interval between expansion/deflection fittings in such runs shall not be greater than 100 feet.

3.8 GROUNDING

A. All raceways shall have a copper system ground conductor throughout the entire length of circuit installed within conduit in strict accordance with NEC codes.

B. Grounding conductor shall be included in total conduit fill determining conduit sizes, even though not included or shown on drawings.

C. Grounding conductors run with exterior/ underground feeders shall be bare only.

D. Grounding conductors run with feeders shall be bonded to portions of conduit that are metal by approved ground bushings.

E. See other sections of these specifications for additional requirements.

F. Grounding conductors (including lightning protection down conductors) run in metal conduit shall be bonded to metal conduit at both ends.

3.9 CONDUITS PENETRATING 2 HOUR ASSEMBLIES OR GREATER

A. Conduits with conductors penetrating the wall shall have blow out patches on each side of the wall.

B. Multiple conduits run through rated walls side by side shall have blow out patches on each side of the wall.

C. Data or telephone conductors run exposed and penetrating a wall rated 2 hour for fire, smoke or smoke/fire shall be sleeved with steel conduits 30" each side of the wall and conduit ends packed with approved fire sealant.

3.10 FIRE AND SMOKE STOPPING

A. Contractor is to provide fire stopping and smoke sealing for all penetrations of existing (or new if applicable) fire or smoke assemblies as required to maintain rating of assembly.

B. All penetrations shall be fire stopped in strict accordance with UL Fire Directory. Submit applicable details for acceptance. Prepare and install as delineated by UL detail(s).

C. Each penetration shall be identified with the corresponding UL fire assembly number. Labels shall be typed or computer generated minimum 1/2” high black lettering, self-adhesive type.

D. Comply with UL Fire Directory "F" and "T" ratings respectfully.

3.11 FIRE PROTECTION

A. Emergency life safety feeder-circuit wiring shall be installed either in spaces fully protected by an approved automatic fire suppression system or shall be a listed electrical circuit protection system with a 1-hour fire rating. Fire circuit protection shall be in accordance with UL Fire Protection equipment Directory and UL Building Materials Directory (latest edition).

3.12 VERTICAL RACEWAYS

A. Cables in vertical raceways shall be supported per NEC Article 300.19. Provide supporting devices for cables, including any necessary accessible pull boxes as required regardless if shown on drawings or not. Provide and install access panels as required. Coordinate location of pull box and access panel with designer prior to installation. This includes empty raceways for future use.

3.13 GENERAL

A. Install conduit in accordance with NECA "Standard of Installation." Contractor shall layout all work prior to rough-in.

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Arrange conduit to maintain headroom and present neat appearance.

D. Route conduit installed above accessible ceilings or exposed to view parallel or perpendicular to walls. Do not run from point to point.

E. Route conduit in and under slab from point-to-point.

F. Do not cross conduits in slab.

G. Maintain adequate clearance between conduit and piping.

H. Maintain 12-inch (300-mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

I. Maintain minimum of 3” inch separation between power and communications raceways. Increase separation if so required to comply with EIA/TIA referenced standards.

J. Systems raceways shall be installed in accordance with ANSI/EIA/TIA Communications Standards.

1. Maintain proper separation between PDS system cables and all power and unshielded cables, as required to prevent noise or crosstalk interference.
2. Raceway bends shall have minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
3. Install raceways so no more than two 90o bends are in any raceway section without a pullbox. Install additional pull boxes as required to maintain maximum of two 90o bends between pull boxes and termination points.
4. Install boxes in straight sections of raceway.

K. Cut conduit square using saw or pipecutter; de-burr cut ends.

L. Bring conduit to shoulder of fittings; fasten securely.

M. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp locations and to cast boxes. Use threaded conduit hubs to fasten conduit to sheet metal boxes, disconnects switches and equipment control panels in wet and exterior locations.

N. Install no more than equivalent of three 90-degree bends between boxes for power and lighting systems. Use conduit bodies to make sharp changes in direction, as around beams, Use appropriate boxes and conduit bodies for fire alarm, voice/data and sound/paging systems. Use factory elbows for bends in metal conduit larger than 2- inch size.

O. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

P. Provide pull boxes, junction boxes and fire barrier at fire rated walls as required by NEC Article 300, whether shown on drawings or not.

Q. Provide continuous fiber poly line 1000 lb. minimum tensile strength pull string in each empty conduit except sleeves and nipples. This includes all raceways which do not have furnished conductors. Pull cords must be fastened to prevent accidental removal. A phenolic or brass nameplate shall be attached to each end indicating the location of both ends of conduit as follows: THIS END = "LOCATION," OTHER END = "LOCATION."

R. Use suitable seals to protect installed conduit against entrance of dirt and moisture and insects.

S. Ground and bond conduit under provisions of Section 26 05 26.

T. Identify conduit under provisions of Section 26 05 53.

U. Install all conduit concealed from view unless specifically shown otherwise on drawings

V. Rigid steel box connections shall be made with double locknuts and bushings.

W. All wire raceways shall be kept clear of plumbing fixtures to facilitate future repair or replacement of said plumbing fixtures without disturbing wire raceways. Except where it is necessary for control purposes, all raceways shall be kept away from items producing heat.

X. All raceway runs in masonry shall be installed at the same time as the masonry so that no face cutting is required, except to accommodate boxes.

Y. All raceways shall be run from outlet to outlet as shown on the drawings, unless permission is granted, to alter arrangement shown. If permission is granted arrangement shall be marked on red lined As-Built drawings as previously specified.

Z. Spare conduit stubs shall be capped and location and use marked with concrete marker set flush with finish grade. Marker shall be 6" round x 6" deep with appropriate symbol embedded into top to indicate use. Also, tag conduits in panels where originating.

AA. All conduit stubbed above floor shall be strapped to a metal channel supported by conduit driven into ground or tied to steel. Spare conduit stubs shall be capped with a UL listed and approved cap or plug for the specific intended use and identified with ink markers as to source and labeled "Spare".

BB. All connections to motors or other vibrating equipment including transformers or at other locations where required shall be made with not less than 12" nor more than 24" of flexible liquid-tight steel conduit, with nylon insulated throat connectors and wire mesh grip fittings at both terminations of conduit. Use angle connectors wherever necessary to relieve angle strain on flex conduit.

CC. Provide a conduit sealing fitting or pliable compound wherever conduit system is exposed to widely temperature changes which may cause condensation within the raceway; as from the inside to the outside of coolers or freezers.

DD. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified under other Sections of these specifications.

EE. All raceways shall be run in neat and workmanlike manner and shall be properly in accordance with latest edition of NEC with approved conduit clamps, hanger rods and structural fasteners.

FF. All raceway runs, whether terminated in boxes or not, shall be capped during the course of construction and until wires are pulled in, and covers are in place. No conductors shall be pulled into raceways until construction work which might damage the raceways has been completed.

GG. Electrical raceways shall be supported independently of all other systems and supports, and shall in every case avoid proximity to other systems which might cause confusion with such systems or might provide a chance of electrolytic actions, contact with live parts or excessive induced heat.

HH. Raceways, boxes, etc. shall not be attached to an acoustical grid ceiling system or support wire per NEC Article 300.11. Support all components directly from building structure.

## END OF SECTION 26 05 33.13

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# SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of pull and boxes.

1.3 DESCRIPTION

A. Provide and install all boxes (flush or surface) complete with all accessories as required to facilitate installation of electrical system and as required by the N.E.C.

B. Section includes: Wall and ceiling boxes and junction and pullboxes.

C. Install pull and junction boxes wherever required for a complete and operating distribution system whether shown on drawings or not.

1.4 SUBMITTALS

A. Submit catalog cut sheet/product data on:

1. Surface cast boxes.

2. Covers.

3. Dimensions - inside and out.

4. Rating of concrete or gauge of metal.

5. Manufacturer

6. All boxes to be used on project.

1.5 PROJECT AS-BUILT DOCUMENTS

A. Record actual locations and mounting heights of pull and junction boxes.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. and requirements of NEC as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

2. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

3. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.

4. ANSI/NFPA 70 - National Electrical Code.

5. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.7 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.

B. Verify locations of outlets in offices and work areas prior to rough-in.

C. Verify locations of pull and junction boxes prior to rough-in.

D. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose and to maintain required access.

## PART 2 - PRODUCTS

2.1 GENERAL

A. Provide box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, boxes, and corrosion-resistant knockout closures compatible with boxes being used and meeting requirements of individual wiring situations.

B. All boxes shall be of the size and shape required by NFPA 70 for their respective locations.

C. Boxes shall be of such form and dimensions as to be adapted to the specific use and location, type of device or fixtures to be used, and number and size of conductors and arrangement, size and number of conduits connecting thereto.

D. Dimensions of pull and junction boxes shall meet dimensions shown on drawings or dimensions required by NEC, whichever is largest.

E. Standard 25 cubic inch pull boxes shall meet the requirements of these specifications for outlet boxes as a minimum.

F. All boxes of 100 cubic inches or more shall be constructed of 14 gauge steel with hot dip galvanized coating.

G. Handy boxes shall not be used.

H. Boxes to be one-piece.

I. 4”x 4" boxes and 4 11/16" x 4 11/16" boxes used as junction boxes shall be one piece.

2.2 SHEET METAL BOXES:

A. ANSI/NEMA OS 1, Galvanized Steel.

B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.

C. Concrete Ceiling Boxes: For concrete location installation, providing fire resistance rating as required.

D. Interior flush boxes shall be galvanized steel constructed with stamped knockouts in back and sides, and threaded holes with screws for securing box coverplates or wiring devices. T & B, Steel City, Raco or approved substitution.

E. Ceiling boxes shall be 4" octagonal or 4" square X 1 1/2" deep or larger as required for number and size of conductors and arrangement, size and number of conduits terminating at them.

F. Switch, wall receptacle, telephone and other recessed wall boxes in drywall shall be 4" square X 1 1/2" deep. For recessing in exposed masonry, provide one piece 4" square x 1 1/2" deep wall boxes with appropriate 4" square cut tile wall covers Steel City series #52-C-49/52-C-52 or approved substitution. For recessing in furred-out block walls, provide 4" square box with required extension for block depth and required extension for drywall depth.

G. For Communication/Systems Telephone, Data, TV, CCTV, Video, and Computer device boxes shall be 4" square x 2 1/8" deep, minimum. Increase box to 4-11/16" with single gang plaster ring as required for special devices respectfully.

H. Large Pull Boxes: Boxes larger than 400 cubic inches in volume or 20 inches in any dimension:

1. Use hinged enclosure under provisions of Section 26 27 16 Electrical Cabinets and Enclosures.

I. Exterior, damp location and wet location pull and junction boxes shall be NEMA 4x stainless steel.

2.3 CAST BOXES:

A. NEMA FB 1

B. Interior surface boxes and conduit bodies installed from 0" AFF to 90" AFF (including fire alarm device backbox) shall be heavy cast aluminum or iron with external threaded hubs for power devices and threaded parts for low voltage devices - Appleton, Crouse Hinds or approved substitution. Trim rings shall also be of one piece construction.

C. Weatherproof boxes shall be constructed of corrosion-resistant cast iron suited to each application and having threaded conduit hubs, cast metal face plate with spring-hinged waterproof cap suitable configured, gasket, and corrosion-proof fasteners.

D. Boxes to be Type FD unless otherwise noted on drawings.

E. Free standing cast boxes are to be type FSY (with flange). Other cast zinc boxes are not acceptable.

2.4 SURFACE-MOUNTED CAST METAL BOX:

A. NEMA 250, Type 4; flat-flanged, surface-mounted junction box.

B. Material: Cast aluminum.

C. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

D. Provide all hubs as required for conduit connections.

2.5 IN-GROUND PULL BOXES:

A. Material: Pre-cast concrete.

B. Bottom: Open with 6" of gravel for drainage.

C. Cover: Meet Florida Dept. of Transportation requirements for heavy traffic.

D. Solid sides constructed to facilitate conduit entries.

**PART 3 - EXECUTION**

3.1 GENERAL

A. Install per NEC.

B. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

C. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.

F. Above ceiling outlet and junction boxes shall be installed to permit readily accessible access from ladder or staging from corresponding floor without the need to extend ladder up through ceiling system to facilitate ease of maintenance.

G. Install boxes to preserve fire resistance rating of partitions and other elements.

H. Align adjacent wall-mounted boxes for switches, thermostats, and similar devices with each other.

I. Outlets for 120V clocks shall be recessed so that the clock will hang flush with the finished surface of the wall.

J. Use flush mounting boxes in finished areas.

K. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches (one stud space) separation in acoustic and rated walls.

L. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

M. Use stamped steel bridges to fasten flush mounting box between studs.

N. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

O. Lighting control switches shall be located at the latch side of door. If the drawings indicate otherwise, issue a request for clarification prior to rough-in.

P. Support all boxes from structure with minimum of one (1) 3/8" all-thread rod hangers. Boxes larger than 25 square inches shall be supported with two (2) all-thread rod hangers, minimum.

Q. Do not fasten boxes to ceiling support wires.

R. Support boxes independently of conduit.

S. Pull boxes shall be installed in straight runs of conduit only. Pull boxes shall not be used in place of a conduit bend.

T. Use gang box where more than one device is mounted together. Do not use sectional box.

U. Use gang box with plaster ring for single device outlets.

V. Comply with applicable portions of the National Electrical Contractor's Association's (NECA) "Standard of Installation".

W. Install outlets in the locations shown on the drawings; however, the OAR shall have the right to make, prior to rough-in, slight changes in locations to reflect room furniture layouts.

X. Coordinate each electrical box so that the type is suitable for the wall or ceiling construction anticipated and suitable fireproofing is built into fire rated assemblies.

Y. Relocate electrical boxes as required so that electrical devices, once installed, will be symmetrically located with respect to the room layout.

Z. All boxes shall be installed in a flush rigid manner with box lines at perpendicular and parallel angles to finished surfaces. Boxes shall be supported by appropriate hardware selected for the type of surface from which the box shall be supported. For example, provide metal screws for metal, wood screws for wood, and expansion devices for masonry or concrete. No surface mounted boxes will be allowed without OAR approval.

AA. For damp and wet locations provide weatherproof boxes and accessories.

BB. As a minimum, provide pull boxes in all raceways over 150 feet long. The pull box shall be located near the midpoint of the raceway length.

CC. Provide knockout closures to cap unused knockout holes where blanks have been removed, and plugs for unused threaded hubs.

DD. Provide conduit locknuts and bushings of the type and size to suit each respective use and installation.

EE. Boxes and conduit bodies shall be located so that all electrical wiring is accessible.

FF. Avoid using round boxes where conduit must enter box through side of box which would result in a difficult and insecure connection with a locknut or bushing on the rounded surface.

GG. All flush outlets shall be mounted so that covers and plates will finish flush with finished surfaces without the use of shims, mats or other devices not submitted or approved for the purpose. Add-a-Depth rings or switch box extension rings (Steel City #SBEX) are not acceptable. Plates shall not support wiring devices. Gang switches with common plate where two or more are indicated in the same location. Wall-mounted devices of different systems (switches, thermostats, etc.) shall be coordinated for symmetry when located near each other on the same wall. Outlets on each side of walls shall have separate boxes. Through-wall type boxes shall not be permitted. Back-to-back mounting shall not be permitted. Trim rings shall be extended to within 1/8" of finish wall surface.

HH. Boxes mounted in metal stud walls, are to be supported to studs with minimum of two (2) self-tapping screws inside, at the back of box, to a horizontal stud brace between vertical studs or pre-manufactured heavy duty box bracket equal to Caddy Corporation # SGB/TSGB series, to prevent movement of box after wall is finished.

II. All boxes that do not receive devices in this contract are to have blank plates installed matching wiring device plates.

JJ. Mount Height.

1. Height of wall outlets to bottom above finished floors shall be as follows, unless specifically noted otherwise, or unless otherwise required by applicable codes including ADA. Verify with the Architectural plans and shop drawings.

   a) Switches: 4'-0" AFF to top

   b) Receptacles: 1'-4" AFF to bottom

   c) Lighting Panels: 6'-6" AFF maximum to centerline of highest breaker/fuse

   d) Phone Outlets: 1'-4" AFF to bottom

   e) ADA Wall Phones: (See part 3.1, Item HH.(4.) below)

   f) Fire Alarm Pull Stations: 4'-0" AFF to top

   g) Fire Alarm Strobe Lights: 80" AFF to bottom of globe or 6" below ceiling to top, whichever is lower

2. Bottoms of outlets and switches above counter tops or base cabinets shall be minimum 2" above counter top or backsplash, whichever is highest. Outlets and switches may be raised so that bottom rests on top of concrete block course, but all outlets above counters in same area shall be at the same height. Coordinate outlet locations in relation to all casework shown on Architectural plans, prior to rough-in, regardless of height shown on Electrical drawings.
3. Height of wall-mounted fixtures shall be as shown on the drawings. Fixture boxes shall be equipped with fixture studs when supporting fixtures.
4. Coordinate locations and mounting heights of boxes for all phones with architect, phone system installer and approved shop drawings prior to rough-in. Install as directed, including requirements of ADA. In general, ADA wall phones shall be at a maximum of 54" to highest operable part essential to basic operation of telephone with side reach and maximum of 48" forward reach as defined by 3.1 HH.1.

KK. Special Purpose Outlets.

1. Locate special purpose outlets as indicated on the drawings for the equipment served. Location and type of outlets shall be coordinated with appropriate trades involved. Coordinate roughing-in locations. Provide plug for each outlet.

LL. Outlets in Rated Assemblies and Smoke Barriers.

1. Metallic and approved non-metallic electrical boxes may be installed in vertical fire resistive assemblies or smoke barriers without affecting the classification, provided such openings occur on one side only in each framing space and that openings do not exceed 16 sq. inches.

2. All clearances between such boxes and the gypsum board must be completely filled with joint compound or other approved materials.
3. The wall must be built around outlets of larger size so as not to interfere with the integrity of the wall rating.

3.2 IN GROUND PULL BOXES

A. Provide and install ground rod in each pull box. Connect #2 copper ground wires (counterpoise) to ground rod, run out pullbox 6" over conduits to next pull box; tie to respective building electrical ground rod at each building.

B. Install pull boxes flush with finished grade. Provide extensions as required.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Coordinate installation of box for products furnished under all Sections of these specifications.

B. Coordinate locations and sizes of required access doors with applicable sections in these specifications.

C. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

D. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

E. Position boxes to locate luminaires as shown on reflected ceiling plan.

3.4 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closure in unused box opening.

C. Install pull and junction boxes as shown on drawings or as required by the National Electric Code (NEC). Identification of boxes is required. Phenolic labels or permanent marks with voltage, circuit, panel, fed from, location of source, location of load.

D. Pull and junction boxes (not in-ground type) used for systems larger than 25 square inches shall be hinged cover type with flush latches operated with screwdriver.

E. Pull and junction boxes larger than 25 square inches shall be supported with (2) all-thread rod hangers minimum. Increase quantity and size of all-thread rod hangers as required for application, and to eliminate movement and swaying.

## END OF SECTION 26 05 33.16

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# SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of identification for electrical equipment.

1.3 DESCRIPTION

A. Provide and install all equipment, labor and material for a complete identification system, including but not limited to:

1. Nameplates and labels.

2. Wire and cable markers.

3. Conduit markers.

4. Identify all new and existing conduits, boxes, equipment, etc. as specified herein.

1.4 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.

2. Americans with Disabilities Act - 1990.

## PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Nameplates for Emergency Branch Power shall be laminated red phenolic plastic with chamfered edges and white engraved lettering. Orange phenolic plastic border to be added around nameplate to denote branch.

B. Letter Size:

1. 1/8 inch for identifying individual equipment and loads.

2. 1/4 inch for identifying grouped equipment and loads.

C. Nameplates shall adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop

drawing submitted for approval. Nameplates for panelboards and switchboards shall include the panel designation, voltage and phase of the supply. For example, "Panel A, 120/208V, 3-phase, 4-wire". In addition, provide phenolic label in panel to describe where the panel is fed from. For example, "Fed From MDP-1:3:5". The name of the machine on the nameplates for a particular machine shall be the same as the one used on all motor starters, disconnect and P.B. station nameplates for that machine.

D. The following items shall be equipped with nameplates: All motors, motor starters, motor-control centers, push-button stations, control panels, time switches, disconnect switches, transformers, panelboards, circuit breakers (i.e., all 2 pole, 3 pole C.B.'s), contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical, and electrical systems junction and pull boxes (larger than 4 11/16"), terminal cabinets, terminal boards, and equipment racks. Nameplates shall also describe the associated panel and circuit number (if applicable).

E. All receptacles shall be clearly labeled with panel/circuit designation.

F. All junction/pull boxes shall receive phenolic labels clearly labeling circuitry/cabling/etc., within.

2.2 WIRE MARKERS

A. Description: Cloth, tape, split sleeve, or tubing type wire markers.

B. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings including neutral conductor.

2. Low voltage circuits (circuits under 120V):

D. Control wire number indicated on schematic and interconnection diagrams on shop drawings.

2.3 CONDUIT/JUNCTION BOX COLOR CODE

A. All conduit system junction boxes (except those subject to view in public areas) shall be color coded as listed below:

| Color Code for Junction Boxes | Krylon Paint Number |
|---|---|
| System Emergency 277/480 volt | Cherry Red K02101 |
| System Emergency 120/208 volt | Zinger Pink S01150 |
| Fire Alarm | Popsicle Orange K02410 |
| Normal Power 277/480 Volt | Leather Brown K02501 |
| Normal Power 120/208 Volt | Glossy Black K01601 |
| Fiber Optics | Plum Purple K01929 |
| Sound System | Daisy Yellow K01813 |
| Clock | Light Blue S01540 |
| Intercom | True Blue K01910 |
| Computer Data | Gold K01701 |
| TV | Glossy White K01501 |
| BAS | Cameo White K04129 |
| FIDS/BIDS | Saddle Tan K03554 |

| | |
|---|---|
| Security/CCTV | John Deer Green K01817 |
| Telephone | Clover Green K02012 |
| Grounding | Fluorescent Green K03106 |
| Access Control System | John Deer Green K01817 |
| Lightning Detection & Notification | Global Blue K03546 |
| Elevator Status | Georgia Clay K03531 |
| 800 Mhz Radio | Copper Metallic K02203 |
| FCIC | Clover Green K02012 |
| Positron | Clover Green K02012 |
| DC Controls | Clover Green K02012 |
| Duress | Fresh Salmon K03536 |
| Fire Pump Status | Popsicle Orange K02410 |
| Emergency Generator Status | Zinger Pink S01150 |

B. Conduits (not subject to public view) longer than 20 feet shall be painted with above color paint band 20 ft. on center. Paint band shall be 4" in length. Where conduit are parallel and on conduit racking, the paint bands shall be evenly aligned. Paint shall be neatly applied and uniformed. Paint boxes and raceways prior to installation or tape conduits and surrounding surfaces to avoid overspray. Paint overspray shall be removed.

C. Junction boxes and conduit located in public areas (i.e. areas that can be seen by the public) shall be painted to match surface attached to. Provide written request to DESIGNER for interpretation of those public areas which may be in question.

D. Where two colors apply to the same raceway, paint on opposite corners leaving room for panel/ckt./system/etc., labeling in center.

E. The Contractor may utilize conduit banding tape instead of paint, on interior conduits only, where specified colors are available. Surface of conduits shall be thoroughly cleaned prior to tape application, and tape shall be applied in a neat and workmanlike manner. Tape to be manufactured by Seton Identification Products only.

2.4 CONDUIT/JUNCTION BOX MARKER

A. All new and existing junction boxes/cover plates for power, lighting and systems (except those installed in public areas) shall adequately identify its associated systems panel and circuit number. Identification shall be by means of black permanent marker. (Paint one-half cover plate with appropriate color above, and one-half with associated panel/circuit or system as described above.)

2.5 DEVICE COVER PLATE IDENTIFICATION

A. Description: Self-adhesive clear printed labels with Black typed letters (pre-printed, dot matrix, or laser).

B. Locations:

1. Each new receptacle cover plate.

2. Each existing receptacle cover plate in areas of remodel/renovation.

C. Legend:

1. Receptacle plates shall adequately describe its associated panelboard and circuit reference.

2. System plates shall adequately describe its terminal board, or terminal cabinet, termination cable identifier and assigned user code number.

2.6 UNDERGROUND WARNING TAPE

A. Description: 6 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines, one strip per 24" of duct.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using stainless steel pop rivets.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Nameplates installed inside on dead front cover shall be self adhesive tape. (Do not drill or install screws in dead front.)

E. Identify new and existing conduit, junction boxes, and outlet boxes using field painting.

F. Identify new underground conduits using underground warning tape. Install one tape per 24 inches of trench at 3 inches below finished grade.

G. Install wire markers at all new and existing connections and terminations.

## END OF SECTION 26 05 53

# SECTION 26 05 73 – OVERCURRENT PROTECTION DEVICE COORDINATION STUDY

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Std. 1584-2002 equations that are presented in NFPA70E-2009, Annex D.

C. The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract as well as all directly affected existing distribution equipment associated with the Project.

1.3 DESCRIPTION

A. Provide all labor, materials, and equipment necessary to properly and completely perform a Power Systems Study for the electrical distribution and control equipment and submit results in a report.

B. Electrical distribution and control equipment is to include all equipment installed under this contract and all existing equipment that this project is connecting to, complete from new equipment to existing power company transformer(s) via all applicable existing power distribution and control equipment.

C. Provide an up to date electrical system single-line diagram as required by NFPA 70E, “Standard for Electrical Safety in the Workplace,” as referenced in OSHA 29 CFR 1910 Subpart S, Appendix A. This information shall include nameplate data for electrical components (e.g. transformers, medium voltage switchgear, panelboards, switchboards, motor control centers, etc.) for all portions of the electrical system from the utility intertie through the lowest rated panel.

D. Cable sizes, types and lengths between electrical equipment components and up to date utility source data shall be provided for an accurate single-line representation of the electrical system. Unique characteristics of the equipment installation shall be provided which may impact the magnitude of the potential hazard (e.g. open space versus enclosure). Overcurrent device settings shall be verified.

E. Data collection may require removal of barriers, opening of front panels, etc. while equipment is energized. The Contractor must provide proof (written documentation) that its employees working on the premises of the Landside Building have been properly trained in the use and application of personal protective equipment (PPE) and the hazards of working on or near energized equipment. The Contractor must provide its own PPE protection with a minimum arc thermal performance rating (ATPV) of 40 calories/cm2.

F. The contractor shall be responsible for obtaining all required data of all equipment.

G. The study shall verify adequacy of all equipment implemented under these specifications and to verify the correct application of circuit protective devices and other system components specified completely coordinated with the existing system.

H. A comprehensive analysis of the electrical system shall be performed for all equipment up to 480 volts and by a 125kVA or larger transformer based on the up to date single-line diagram provided from "Section A". This analysis shall include the following:

1. Short Circuit Study – A short circuit analysis shall be performed in accordance with ANSI standard C37 and IEEE standard 141-1993 (Red Book) for each electrical component as defined in "Section A. "

2. Coordination Study – A coordination study shall be performed in accordance with IEEE 242-2001 "Buff" to determine the proper overcurrent device settings that will balance system reliability through selective coordination while minimizing the magnitude of an electrical arc flash hazard incident.

3. Incident Energy Study – An incident energy study shall be done in accordance with the IEEE 1584-2004a, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70, "Standard for Electrical Safety in the Workplace", latest revision, in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.

I. Reconcile arc flash protective device setting recommendations with the protective device time-current coordination study.

J. Adjust the System Design to optimize the results of the study as it relates to safety and reliable electrical system operation (e.g. overcurrent device settings, working distances, current limiting devices). This includes mitigation, where possible, of incident energy levels that exceed 40 calories/cm2. A qualified engineer with power systems design experience shall provide this assistance

K. The intent /goal of the protective system included herein is to establish arc flash levels that result in PPE levels of Category 2 or less.

L. Identify locations where Category 2 cannot be achieved.

M. The study shall address the case when the system is being powered from the normal source as well as from the on-site generating source.

N. Minimum as well as maximum possible fault conditions shall be covered in the study.

O. Fault conditions of all motors shall be considered.

1.4 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and

Commercial Power Systems

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis

4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

6. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.5 SUBMITTALS FOR REVIEW/APPROVAL

A. The short-circuit and protective device coordination results shall be submitted prior to receiving final approval of the distribution equipment shop drawings and prior to release of equipment drawings for manufacturing. This preliminary submittal of study data shall be sufficient to ensure that the selection of device and characteristics will be satisfactory.

B. SUBMITTALS FOR CONSTRUCTION

C. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.

D. For large system studies with more than 200 bus locations, the contractor is required to provide the study project files to the Owner in electronic format. In addition, a copy of the computer analysis software viewer program is required to accompany the electronic project files, to allow the Owner to review all aspects of the project and print arc flash labels, one-line diagrams, etc.

E. The report shall include the following sections:

1. Executive Summary.

2. Descriptions, purpose, basis and scope of the study

3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties

4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection

5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout

6. Details of the incident energy and flash protection boundary calculations

7. Recommendations for system improvements, where needed

8. One-line diagram

F. Arc flash labels shall be provided in hard copy only. For large system studies (more than 200 bus locations) arc flash labels shall be provided in hard copy and label images shall be provided in electronic format.

G. Report shall include:

1. Available fault current at each equipment location with comparison to equipment rating

2. Overcurrent device settings (e.g. pick-up, time delay, curve), “as found” and “as recommended”

3. Incident energy level (calories/cm2) for each equipment location and recommended PPE

4. Overcurrent device coordination curves including related section of the single-line diagram

5. List of prohibited energized work locations based on arc flash results.

1.6 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.7 COMPUTER ANALYSIS SOFTWARE

A. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program or prior approved equal.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

3.1 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer or an approved engineering firm.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

3.2 DATA COLLECTION

A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination shall include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor when available.

D. Include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

3.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

B. Minimum transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions

2. Selected base per unit quantities

3. One-line diagram of the system being evaluated

4. Source impedance data, including electric utility system and motor fault contribution characteristics

5. Tabulations of calculated quantities

6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point

2. Incoming switchgear

3. Unit substation primary and secondary terminals

4. Low voltage switchgear

5. Standby generators and automatic transfer switches

6. Branch circuit panelboards

7. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings

2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses

3. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

## 3.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable,

tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device

2. Medium voltage equipment overcurrent relays

3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands

4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands

5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves

6. Conductor damage curves

7. Ground fault protective devices, as applicable

8. Pertinent motor starting characteristics and motor damage points, where applicable

9. Pertinent generator short-circuit decrement curve and generator damage point

10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

3.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE Std. 1584-2002 equations that are presented in NFPA70E-2009, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE Std. 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

3.6 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).

2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.

3. Reactor data, including voltage rating, and impedance.

4. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X'd), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.

5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a) Voltage

b) Calculated fault current magnitude and angle

c) Fault point X/R ratio

d) Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a) Voltage

b) Calculated symmetrical fault current magnitude and angle

c) Fault point X/R ratio

d) Calculated asymmetrical fault currents

1) Based on fault point X/R ratio

2) Based on calculated symmetrical value multiplied by 1.6

3) Based on calculated symmetrical value multiplied by 2.7

e) Equivalent impedance

3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a) Voltage

b) Calculated symmetrical fault current magnitude and angle

c) Fault point X/R ratio

d) No AC Decrement (NACD) Ratio

e) Equivalent impedance

f) Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis

g) Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:

a) Current transformer ratio

b) Current setting

c) Time setting

d) Instantaneous setting

e) Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

a) Adjustable pickups and time delays (long time, short time, ground)

b) Adjustable time-current characteristic

c) Adjustable instantaneous pickup

d) Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations

1. Arcing fault magnitude

2. Protective device clearing time

3. Duration of arc

4. Arc flash boundary

5. Working distance

6. Incident energy

7. Hazard risk category

8. Recommendations for arc flash energy reduction

## 3.7 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the contractor and/or electrical equipment manufacturer's field service personnel.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

## 3.8 ARC FLASH WARNING LABELS

A. The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation

2. Nominal voltage

3. Flash protection boundary

4. Incident energy or energy range corresponding to reported Hazard risk category.

5. Working distance

6. Engineering report number, revision number and issue date.

D. Labels shall be machine printed, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 600, 480 and applicable 208 volt panelboard, at least one arc flash label shall be provided.

2. For each switchboard, one arc flash label shall be provided.

3. For each main switchboard with Utility Service, one flash label shall be provided for each section.

F. Labels shall be field installed by the contractor.

## 3.9 ARC FLASH TRAINING

A. The contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

## END OF SECTION 26 05 73

# SECTION 26 08 10 - TESTS AND PERFORMANCE VERIFICATION

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for the furnishing of all labor, materials, equipment and services necessary to test and prove performance of the electrical system.

1.3 DESCRIPTION

A. Operate system for a 3-day period. Do performance verification work as required to show that the system is operating correctly in accordance with design. Supply instruments required to read data. Adjust system to operate at the required performance levels.

## PART 2 - PRODUCTS – (not applicable)

## PART 3 – EXECUTION

3.1 TESTS

A. System:

1. General: After installation of all conductors, and before final acceptance, make required tests to determine proper function of all circuits. Furnish all necessary instruments required to make tests, and correct any deficiencies found. Prior to energizing, circuits shall be tested to verify opens, intentional and non-intentional grounds, and continuity and detect short circuits by approved constant "megger".
2. Procedure:

a. Insulation resistance of all circuit conductors shall be tested. This is to include all new conductors and all existing conductors that are connected or extended. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps, and connections are made except connection to source and point of final termination at distribution or utilization equipment.

b. Insulation resistance of conductors that are to operate at 600 volts or less shall be tested by using a megohmmeter at not less than 1000 volts DC. Resistance shall be measured from each conductor to all other conductors and from each conductor to conduit (ground).Test duration shall be one minute. Investigate any values which deviate from similar connections by more than 50 percent of the lowest value. Testing methodology shall conform to National Electrical Testing Association (NETA). Acceptable insulation resistance of conductors rated at 600 volts shall not be less than the recommended wire manufactures accepted values and test equipment manufacture, or 50 megohms, which ever is greater.

c. Conductors that do not satisfy test requirements (b. above) shall be removed, replaced, and testing repeated on new cable, at no additional costs to the Owner. All tests shall be performed by a licensed electrician trained in the use of the test instrument.

d. Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed and complete "Conductor Insulation Resistance Test" form (found in Division 01) and submit five (5) copies to Designer/OAR for approval. Test shall be witnessed by OAR and designer (if designer so desires). Final approval data is to be submitted in O&M Manual.

e. Test reports shall identify each feeder conductor tested, date, time, and result of test, weather conditions, and range, test voltage, and serial number of the megger instrument used. Any conductor or splice that is found defective shall be promptly removed and replaced, and additional test shall be performed.

f. Observe all safety instructions set by testing equipment manufacturer to minimize risk of electric shock and sparking.

3. Take readings of voltage and amperage at building main disconnect switch and at main for each panel (panelboard, distribution panel, switchboard), at primary and secondary side of each transformer, at each major item of equipment, and at the end of the longest branch circuit at each panel. The above readings shall be taken (1) "no load" conditions and (2) "full load" conditions with all equipment using electricity. Tabulate readings, complete "TABULATED DATA VOLTAGE AND AMPERAGE READINGS" form included in Division 01. Final approved data is to be submitted in O & M manual.

B. Motors:

1. Test run each motor via motor's control unit in both manual mode and automatic mode. Verify proper operation and voltage.

2. Test run each motor furnished in the Work and all existing motors specifically noted in the Contract Documents to be tested:

a. With the system energized, line-to-line voltage and line current measurements shall be made at the motors under full load conditions. Should measured values deviate +/- 5% from the nameplate ratings, the condition shall be corrected. Notify the designer immediately should deviations occur.

b. Record results of existing motors tested and submit values to OAR in writing.

C. Grounds:

1. Test each raceway for raceway continuity as called for in Section 26 05 26.

2. Test each grounding system used in the project as called for in Section 26 05 26

3. Submit "GROUND TEST INFORMATION" form included in Division 01 of the General Requirements for each and every grounding system in the project including but not limited to: each ground rod installation; each water pipe and ground installation (test water pipe to ground and test water pipe to building service equipment); and each building steel ground connection (test building steel to ground and test building steel to building service equipment). Final approved data is to be submitted in O & M manual.

4. Grounding resistance shall be as called for in Section 26 05 26.

5. Testing shall be three (3) point method in accordance with IEEE recommended practice.

D. Communications:

1. See specific sections of these specifications for requirements.

E. Equipment:

1. Equipment items requiring check-out memos are all major items of equipment such as (but not limited to):

a. Panelboards, switchboards.

b. Transformers.

c. UPS equipment.

d. Generator equipment.

e. Checkout and test any other equipment the designer/OAR deems necessary to insure system integrity and safety during construction, regardless if previous testing has been performed.

2. At completion of construction after all performance verification and testing information has been gathered, submitted, and approved, provide one copy of this information to the authorized manufacturer's representative of the equipment.

a. Manufacturer's authorized representative must be trained by the manufacturer and authorized to inspect, adjust, test, and repair equipment.

3. Manufacturer’s authorized representative shall examine the performance verification information, check the equipment in the field while it is operating, and sign a check-out memo for a record.

a. Check out of equipment is to include examining performance and certifying equipment has been installed per manufacturer's recommendations, that all necessary adjustments have been performed and that equipment is operating properly.

4. Submit memo on each major item of equipment. Approved memos shall be scanned and copied onto each O & M CD with the performance verification information and submittal data. Memos shall be submitted and approved before instruction to Owner or a request for final inspection.

5. Do not submit Check-out Memo form at the time Submittal Brochures are submitted.

6. Completion of Construction “Check Out Memo” form included in Division 01.

## 3.2 DATA PROCESSING

A. Tabulate data for submission.

B. Submit data/results electronically.

C. Where specific performance verification information is called for in the specifications, use copies of the sheets provided for recording readings.

D. Data shall be submitted and approved before Check Out memos are signed or a request for final inspection is made.

## END OF SECTION 26 08 10

# SECTION 26 08 20 - DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for demonstration of completed electrical system.

1.3 DESCRIPTION

A. Demonstrate to Owner/Engineer the essential features of the following electrical systems:

1. Systems specified in Division 26.
2. Electrical Entrance Equipment
    a) Circuit breakers
    b) Fuses and fuseholders
    c) Meters (where applicable)
3. Miscellaneous Electrical Equipment
    a) Electrical systems controls and equipment
    b) Electrical power equipment
    c) Relays
    d) Special transformers
    e) Starting devices
    f) Surge suppression equipment
4. Lighting Fixtures (include relamping and replacing lenses)
    a) Exit and safety fixtures
    b) Fixtures, indoor and outdoor
5. Lightning Protection System
6. Distribution Equipment
    a) Lighting and appliance panelboards
    b) Distribution panels

c) Switchboard

d) Voltage stabilizers

7. Standby Electrical Equipment

a) Batteries

b) Battery chargers

c) Controls and alarms

d) Emergency generators, transfer switches, paralleling switchboards

e) UPS systems

8. Wiring Devices

a) Low-voltage controls

b) Switches: regular, time

B. After the completion of testing, each system shall be demonstrated to operate successfully as intended.

1.4 TIME

A. The demonstration shall be held upon completion of all systems at a date to be agreed upon in writing by the ENGINEER.

1.5 ATTENDING PARTIES

A. Provide the demonstration in the presence of the Owner, ENGINEER and the manufacturer's representative.

1.6 DEMONSTRATION

A. Demonstrate the function and location (in the structure) of each system, and indicate its relationship to the riser diagrams and drawings.

B. Demonstrate by "start-stop operation" how to work the controls, how to reset protective devices, how to replace fuses, and what to do in case of emergency.

C. Certificate of Completed Demonstration

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION**

3.1 EXECUTION

A. After the completion of testing, each system shall be demonstrated to operate successfully as intended.

B. The demonstration shall be held upon completion of all systems at a date to be agreed upon in writing by the ENGINEER.

C. Provide the demonstration in the presence of the Owner, ENGINEER and the manufacturer's representative.

D. Demonstrate the function and location (in the structure) of each system, and indicate its relationship to the riser diagrams and drawings.

1. Submit Certificate of Completed Demonstration Memo Form (found under Division 1) signed by the contractor, subcontractor and ENGINEER for "each" type of equipment and system. Complete an individual form for each item, equipment and system. Insert one copy in each O & M manual.

## END OF SECTION 26 08 20

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# SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 26 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. In wall timer switches
2. Outdoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relays.

B. Related Sections include the following:

1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: Include dimensions and data on features, components, options, NRTL listings, wiring diagrams, and electrical ratings for each type of product to be utilized.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

B. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions

1.7 SPECIAL WARRANTIES

A. Occupancy Sensors shall be provided with a 5 year extended warranty.

**PART 2 - PRODUCTS**

2.1 IN WALL TIMER SWITCH

A. In wall single pole timer switch (120/277V, 6A).

B. Automatically turns lights off after a preset time adjustable time setting from 5 min to 12 hours. Set default time out period to 2 hours

C. Visual warning alert before lights turn off. One flash at 2 to 5 min prior to turn off and flash twice at 1 min to 15 sec prior to turn off.

D. Basis of design is Wattstopper TS-400

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

1. Hubbell Lighting.

2. Leviton Mfg. Company Inc.

3. Watt Stopper

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Intermatic, Inc.

2. Paragon Electric Co.; Invensys Climate Controls.

3. TORK.

B. Description: Solid state, with SPST dry contacts rated for 2000-W tungsten or 1800VA ballast, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 15 fc (16.14 to 162 lx), with an adjustment for turn-on and turn-off levels within that range, and a sliding light level selector in front of photocell to prevent fixed light sources from causing turn-off.

2. Time Delay: Up to 2 minutes to prevent false operation.

3. Mounting: ½" conduit or box mounting as required to direct sensor to the north sky exposure.

4. Temperature Range: -40 Deg F to +140 Deg F (-40 Deg C to +60 Deg C)

5. Heavy-duty die cast zinc, gasket for maximum weather protection.

2.3 INDOOR OCCUPANCY SENSORS

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

1. Hubbell Lighting.

2. Leviton Mfg. Company Inc.

3. Watt Stopper

B. Line Voltage Wall switch: Wall mounting, solid-state units with an integral relay unit.

1. Operation: Unless otherwise indicated, turn lights on manually and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Set switches for manual on and 30 minute delay to off in unoccupied state.

2. Mounting:

a. Sensor: Suitable for mounting in a standard outlet box.

b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

3. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

4. Bypass Switch: Override the on function in case of sensor failure or fail safe in the on position.

5. Sensor: Dual-Technology Type, wall mounting; detect occupancy by using a of PIR detection and retain detection with microphonic or ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

6. Sensitivity Adjustment: Separate for each sensing technology.

7. Detection Coverage (Standard Room): Detect occupancy anywhere within area of installation at a minimum. See drawings for type of detector to be utilized.

8. Design selection: Wattstopper DW-100 or equal

C. Low Voltage Sensors with Power Pack: Ceiling-mounting, solid-state units with a separate relay unit (Power Pack).

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Set time delay to 30 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit. Up to 14 sensors may control 1 relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70 for up to 14 sensors.

4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

6. Bypass Switch: Override the on function in case of sensor failure or fail safe in the on position.

7. Sensor: 360 deg passive infrared (PIR) detector (up to 1200sf) to turn lights on and off based on occupancy, isolation relay and light level sensor . Particular technology that controls on-off functions shall be selectable in the field by operating controls on unit.

8. Accepts low-voltage switch input for manual-on operation

9. Sensitivity Adjustment: PIR high to low.

10. Detection Coverage (Standard Room): Detect occupancy anywhere within area of installation at a minimum. See drawings for type of detector to be utilized.

11. Design Selection: Wattstopper CI-300 with BZ-150 series power pack or equal.

## 2.4 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley; a division of Rockwell Automation.

2. Eaton Electrical Inc.; Cutler-Hammer Products.

3. Square D; Schneider Electric.

B. Description: Electrically operated and mechanically held complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or

less total harmonic distortion of normal load current). Provide 20A minimum rating for all contacts.

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure or as specified.

5. Control Coil Voltage: Match control power source.

6. When multiple contactors are installed with a single enclosure, the assembly shall be UL 508A listed as a control assembly.

2.5 EMERGENCY SHUNT RELAY

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

1. Lighting Control and Design, Inc.

2. Integrated Lighting Control

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts. Device shall be UL 924 listed.

1. Coil Rating: 120 or 277 V.

2.6 EMERGENCY SWITCHING RELAY

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

1. LVS Controls Inc

B. Description: Automatically connects emergency loads upon utility power interruption regardless of switch position and switches lights with the normal lighting switch under normal conditions (no emergency lighting switch is required). Device shall be UL 924 listed and 20A rated contacts. Coil Rating: 120 or 277 V.

C. Include an automatic diagnostic which is initiated when the room switch is turned off. This test procedure will turn the emergency luminaires on for at least 2 seconds, indicating that an emergency power source is available & that the device, ballast, & lamp are all functioning correctly. Automatic diagnostic shall be approved to meet periodic testing requirements (NEC 700.3 NFPA 101 7.9.3

D. Unit shall have regular power indicator LED indicating utility power status.

E. Unit accepts separate phases on the constant hot & switched hot inputs.

F. 5-year manufacturer’s warranty

G. Basis of design is LVS – EPC-A-1

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install equipment level and plumb and according to manufacturer's written instructions.

B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section "Basic Electrical Materials and Methods."

C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

D. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A

E. Bundle, train, and support wiring in enclosures.

F. Ground equipment.

3.2 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 95 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Install in accordance with manufacturers recommendations, which shall determine final sensor location. All sensors shall have non-adjustable factory calibrated sensitivity for maximum performance. Set all time delays for 30 min to avoid nuisance turn off's.

3.3 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

B. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

C. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

C. Provide warning labels on all equipment with more than one source of power located within the enclosure in accordance with Division 26 Section “Identification for Electrical Systems”.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.

2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. Demonstrate products specified in this Section to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

## END OF SECTION 26 09 23

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# SECTION 26 22 00 – LOW-VOLTAGE TRANSFORMERS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of low-voltage transformers.

1.3 DESCRIPTION

A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for low-voltage transformers.

1.4 SUBMITTALS

A. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 QUALIFICATIONS

A. Manufacturer: Same as for products specified in Section 26 24 16 Panelboards.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and tested by UL as suitable for purpose specified and shown.

B. Conform to requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.

2. NECA - Standard of Installation.

3. NEMA ST 1 - Specialty Transformers.

4. NEMA ST 20 - Dry Type Transformers for General Applications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store, protect, and handle products per manufacturer’s recommendations.

B. Deliver transformers individually wrapped for protection and mounted on shipping skids.

C. Accept transformers on site. Inspect for damage.

D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton.

2.2 TWO-WINDING TRANSFORMERS

A. Description:

1. NEM2A ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated.

2. Transformers serving computer loads (whether shown on drawings or not) shall be Non-Linear load K-13 rated.

3. Other Non-Linear load transformers shall be as scheduled and noted on drawing.

4. Isolation and shielded type transformers (if applicable) shall be as scheduled and noted on drawings.

B. Insulation system and average winding temperature rise for rated KVA as follows:

1. 1-15 KVA: Class 185 with 115 degrees C rise.

2. 16-500 KVA: Class 220 with 115 degrees C rise.

C. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point.

D. Winding Taps:

1. Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

2. Transformers 15 KVA and Larger: NEMA ST 20.

E. Sound Levels: NEMA ST 20.

F. Basic Impulse Level: 10 KV.13

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Mounting: Suitable for wall, floor, or trapeze mounting, except transformers larger than 30 KVA, suitable for floor or trapeze mounting.

I. Coil Conductors: Continuous windings with terminations brazed or welded.

J. Transformer windings shall be continuous wound copper (98% conductivity) construction.

K. Enclosure: NEMA ST 20; Type 1 or Type 3R ventilated as indicated. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: Include transformer connection data.

N. Lugs: Suitable for terminating conductors sized for full load ampacity of transformer unit. Transformer lugs and mounting hardware shall be furnished by Manufacturer of transformer and shall be grade 5 with beveled washers. Hardware shall be of suitable size of pad opening per NEMA Standards.

2.3 SOURCE QUALITY CONTROL

A. Provide production testing of each unit in accordance with NEMA ST 20.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify site condition. Do not install NEMA 1 equipment until building has reached the “dried-in” stage.

B. Verify that surfaces are suitable for installing transformer supports.

3.2 PREPARATION

A. Concrete Pad: Design per manufacturer’s requirements plus three inches on all sides.

3.3 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Set transformer plumb and level.

C. Maintain clearances around enclosure for ventilation in accordance with manufacturer's instructions.

D. Use flexible conduit, under the provisions of Section 26 05 33, one foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

F. Provide grounding and bonding in accordance with Section 26 05 26.

G. Ground per NEC 250-26 and to meet local codes as applicable. Grounding lugs shall be multi-conductor type UL Listed for quantity and size of conductors terminated.

H. Wall Mounted Transformers: Wall brackets shall be securely attached to concrete or masonry construction only and have supplemental support by means of all-thread rod hangers from superstructure above. Wall mounted transformers at non structural walls shall be supported from superstructure above with all-thread rod hangers, angle iron channel site manufactured structural stand, or combination thereof.

1. Installation of wall mounted transformers shall be installed to maintain clear space about/above panels as defined by NEC.

I. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

3.4 FIELD QUALITY CONTROL

A. Install field inspect and test per manufacturer recommendations prior to energizing.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

## END OF SECTION 26 22 00

# SECTION 26 24 16 - PANELBOARDS

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of panelboards.

1.3 DESCRIPTION

A. Provide all labor, materials, and equipment necessary to properly and completely install panelboards as scheduled on the drawings and as required by this section.

1.4 SUBMITTALS

A. Submit product data on each basic panelboard construction type, showing manufacturer's standard construction data including:

1. Cabinet construction/dimensions.
2. Bus construction.
3. UL labeling.
4. Each overcurrent device.

B. Shop drawings shall be submitted for each panel and clearly indicate the following information:

1. Label.
2. Each circuit breaker amperage rating, circuit number and position/location in panel.
3. Electrical characteristics of panel.
4. Mains rating.
5. Main device rating.
6. Mounting.
7. Dimension, width, depth, height.
8. Bus material.
9. Interrupting capacity of minimum rated breaker.
10. Panel type.

1.5 PROJECT AS-BUILT DOCUMENTS

A. Record actual locations of Panelboards on red lined as-built documents and indicate actual branch circuit arrangement.

1.6 OPERATION AND MAINTENANCE DATA

A. Provide spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified for minimum ten years.

1.8 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

B. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.

2. NECA (National Electrical Contractors Association) - "Standard of Installation."

3. NEMA AB 1 - Molded Case Circuit Breakers.

4. NEMA PB 1 - Panelboards.

5. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

6. UL 67 - Panelboards

7. UL 50 - Cabinets and Boxes

8. Fed. Spec. W-P-115C

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as instructed by manufacturer.

1.10 MAINTENANCE MATERIALS

A. Provide two keys per panelboard.

1.11 DELIVERY, STORAGE AND HANDLING

A. Handle panelboards and enclosures carefully to prevent damage.

B. Store equipment indoors and protect from weather.

C. Deliver tubs and internal assemblies sufficiently in advance of installation period as necessary to prevent delay of work.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D, Eaton, or approved substitutions.

2.2 GENERAL

A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1, circuit breaker type, dead front, UL 67.

B. Panelboard Bus: Copper ratings as indicated. Provide copper ground bus in each panelboard. Provide isolated full size neutral bus where neutral is applicable. Provide non-linear load panelboards as specified on drawings. Non-linear panelboards shall have 200 percent rated neutral busbar.

C. Short-Circuit Rating:

1. Minimum short circuit interrupting capacity: 10,000 amperes rms symmetrical for 240 volt panelboards; 14,000 amperes rms symmetrical for 480 volt panelboards. Bus shall be braced for minimum capacity equal to or greater than the lowest breaker symmetrical interrupting capacity. Minimum short circuit rating shall be increased to meet the following requirements:

a) Individual C.B. AIC Rating shown on panel schedules indicate lowest AIC rating allowed for individual circuit breaker in panel.

b) Circuit breakers shall be based on a fully rated system.

c) Circuit breaker types are not specified. Provide breakers to comply with the required AIC specified.

D. Enclosure:

1. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

2. Enclosures shall be provided with blank ends.

3. Where indicated on the drawings, branch circuit panelboards shall be column width type.

4. Regulatory Requirements:

a) NEMA PB 1, Type 1, Interior dry locations.

b) NEMA PB 1, Type 3R, Interior damp locations.

c) NEMA PB 1, Type 4X stainless steel watertight, Exterior locations including those noted on drawings to be NEMA 3R.

d) NEMA PB 1, Type 4X stainless steel watertight, interior wet locations, and wash-down areas, regardless of that noted on drawings.

e) UL 50

E. Cabinet box:

1. 6 inches (153 mm) deep; width: 20 inches (508 mm), minimum.

2. Interior dry and damp locations shall be constructed of galvanized code gauge steel, to prevent rust.

3. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.

F. Cabinet Front:

1. Flush or surface with concealed trim clamps, concealed hinge, and flush lock all keyed alike.

2. Shall be door-in-door construction.

3. Finish in manufacturer's standard baked enamel finish for interior dry locations. Interior damp location panels to be painted with rust inhibit primer epoxy paint top coat system.

4. Exterior, wash-down areas, and Interior wet locations shall be constructed of type 4X stainless steel, watertight.

G. Panels and breakers shall be rated for voltage and class of service to which applied.

H. Spaces:

1. Space provisions or spaces for future breakers shall be located at the bottom of the panel and be fully bussed complete with all necessary mounting hardware less the breaker.

2.3 MAINS

A. Provide main lug only (MLO) or main circuit breaker (MCB) as noted on drawings either by riser diagram or by schedule. Where conflict exists, provide MCB.

B. Regardless of what is shown on drawings provide the following minimum requirements.

1. Main circuit breaker on each panel serving building main if required by applicable codes.

2. Main circuit breaker on each panel fed directly from a transformer (unless disconnect with overcurrent devices is installed in feeder between transformer and panel).

C. Provide lugs as required for conductors being connected to panelboard lugs, circuit breakers, etc.

D. Main circuit breaker is not to be mounted as branch breaker or subfeed breaker.

2.4 CIRCUIT BREAKERS

A. General

1. Molded Case Circuit Breakers: NEMA AB 1, plug-on type for 250V or less, bolt-on type for over 250V, thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL

Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

2. Current Limiting Molded Case Circuit Breakers: NEMA AB 1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole.

B. Main Breakers:

1. Main breakers shall be individually mounted separate from branch breakers.

2. Covered by a metal plate, except for operating handle.

3. Connection from the load's side to the panel bus shall be bus bar. Insulated wire not permitted.

C. Branch Breakers:

1. Thermal-magnetic, molded case, with inverse time-current overload and instantaneous magnetic tripping, unless otherwise shown. Breakers shall be calibrated for 40 degrees C or shall be ambient compensating.

2. Quick-make, quick-break, with tripped indication clearly shown by breaker handle taking a position between ON and OFF.

3. Multi-pole breakers shall have common internal trip. No handle ties between single pole breakers are acceptable for this Project.

4. Single pole 15 and 20 ampere circuit breakers shall be rated for switching duty and shall be labeled as "SWD".

5. Rating shall be as called for under "2.2 GENERAL".

6. Ground Fault Circuit Interrupters (GFI):

a) Provide UL Class (5 milliamp sensitivity) ground fault circuit protection on 120 VAC branch circuits for exterior location receptacles and for interior locations where required by NEC. (These may not be indicated on Panel Schedule.) This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. Provide separate neutral for circuits on GFI breakers whether indicated on drawings or otherwise.

7. Breakers feeding heating and air conditioning equipment shall be rated HACR type breaker.

2.5 SERVICE ENTRANCE EQUIPMENT

A. Panelboards used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

## PART 3 - EXECUTION

3.1 PREPARATION/INSPECTION/EXAMINATION

A. Verify that surface is suitable for panelboard installation. Do not install NEMA 1 equipment until building has reached the “dried-in” stage.

B. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

C. Verify prior to installation that National Electrical Code clearances will be maintained after installation. Rework equipment locations as required to provide electrical code clearances.

D. Start Work only after unsatisfactory conditions are corrected.

E. Submit coordination drawings of all electrical rooms, showing all equipment. Comply with Section 26 00 10 Basic Electrical Requirements.

3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1. Install all panelboards and panelboard enclosures in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practices.

B. Install panelboards plumb. Install recessed panelboards flush with wall finishes. Provide supports in accordance with Section 26 05 29 Supporting Devices.

C. Panelboards shall be provided with structural framing located within gypsum board partitions. All enclosures shall be firmly anchored to walls and supporting structures (where used) using appropriate hardware. Provide supporting channels on walls constructed of gypsum board or where otherwise necessary to provide a mechanically secure and permanent installation. Attach channels to framing provided within gypsum board partitions.

D. Enclosures shall be installed so that the top is 6'-6" above finished floor.

1. Where the size of the enclosure is such that the top cannot be installed at 6'-6", the top of the enclosure shall be kept as low as possible.

E. Panelboard backboxes/trim covers mounted adjacent to each other (i.e. multi-section panels, etc) installed in finished areas be of same size.

F. Provide filler plates for unused spaces in panelboards.

G. Provide typed circuit directory from panelboard manufacturers’ original card stock, for each branch circuit panelboard. Mount a typewritten directory showing the actual circuit numbers, type of load and room names on inside of door. Room names shall be actual names or numbers used, not necessarily shown on the drawings. Progress Drawings shall show same arrangements as the Directory. Revise directory to reflect circuiting changes required to balance phase loads.

H. Provide four each 1-inch spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.

I. Clean the interior of each panelboard before installing conductors. At all times, keep the interior trim and exterior surfaces of the panelboard free of rust and debris. Repaint finishes if necessary.

J. Coordinate all raceways and conductors with their respective panelboards so that all connections and conductors routing present an orderly appearance. Conductors in the panelboards shall be neatly laced and arranged in orderly manner.

K. Collect all keys upon delivery of panelboard. Store keys on one ring to be kept by project superintendent. Forward key ring with keys to engineer at substantial completion.

L. Provide a separate neutral conductor for each GFI breaker. These shall not be combined to serve more than 1 circuit, even where on different phases. Increase plan indications of conductors for neutral wires required, as necessary.

M. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

3.3 IDENTIFICATION

A. Refer to Section 26 05 53 Electrical Identification for products and content.

B. Provide engraved plastic nameplates under the provisions of 26 05 53.

C. Nameplate shall show panel name, voltage and name of panel that feeds this respective panel, and UL short circuit rating.

3.4 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

C. All circuits shall be operated to establish a good working order and checked for shorts.

D. All panel directory circuit numbers shall be checked to verify accuracy of the number.

E. Tests:

1. Test Panelboards and panelboard feeders per requirements of Section 26 08 10 Tests and Performance Verification.

2. Feeder conductors shall be checked by approved means to establish the absence of shorts to ground; insulation value, etc. and the result recorded and submitted to the Designer.

3. Submit Conductor Insulation Resistance Test per requirements of Section 26 08 10.

4. Submit Tabulation Data Voltage and Amperage Readings per requirements of Section 26 08 10.

F. Equipment Checkout:

1. Where and when requested by Designer/ENGINEER provide (during construction):

a) Inspection of equipment by authorized equipment manufacturer technician complete with submittal of statement of findings by technician, and providing any adjustments deemed necessary for a complete and operating system.

3.5 ADJUSTMENT AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Tighten bus connections and mechanical fasteners.

C. Touch up scratched and marred surfaces to match original finish.

## END OF SECTION 26 24 16

# SECTION 26 24 16.13 - DISTRIBUTION PANELBOARDS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specifications sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of distribution panelboards.

1.3 DESCRIPTION

A. Factory-assembled, metal-enclosed panelboard for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed and tested in place.

B. Distribution panelboard shall include all protective devices and equipment as specified, with necessary interconnections, accessories and control wiring.

1.4 SUBMITTALS

A. Product data shall be submitted on each basic Distribution Panelboard construction type, showing manufacturer's standard construction data, including:

1. Cabinet construction/dimensions.

2. Bus construction.

3. UL labeling.

4. Each overcurrent device.

5. Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

6. Provide data on trip units and breaker interface module.

B. Shop drawing shall be submitted for all distribution panelboard for this project clearly indicating the following:

1. Label.

2. Each circuit breaker amperage rating, circuit number and position/location in distribution panelboard.

3. Electrical characteristics of distribution panelboard.

4. Mains rating.

5. Main device rating.

6. Mounting.

7. Dimension, width, depth, height..

8. Bus material.

9. Interrupting capacity of minimum rated breaker.

10. Distribution panelboard type.

11. Engraved nameplate for each overcurrent device.

12. Front and side views of enclosures with overall dimensions shown.

13. Conduit entrance locations and requirements.

14. Frame sizes and Interrupting Capacity of each breaker, and total assembly.

15. Horsepower ratings at rated voltage of fused switches and/or breakers.

16. Labels and labeling.

17. Nameplate on main panelboard only giving name of project; Architect, Engineer and Contractor.

18. Bus bar size, arrangement and spacing.

19. Breaker interface module.

20. SPD Equipment

21. Metering/Monitoring Equipment

C. Submit Manufacturer's Instructions indicating application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Submit Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

E. Submit Spare Parts Certification Memo signifying that the spare parts required by the drawings and/or specifications have been turned over to the Owner.

1.5 PROJECT AS-BUILT DOCUMENTS

A. Record actual locations of distribution panelboards on red lined as-built documents indicating actual circuit arrangement.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years experience.

1.7 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code.

2. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

3. NEMA KS 1 - Enclosed Switches.

4. NEMA PB 1 - Panelboards.

5. NEMA PB 1.1 - Instructions for safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

6. UL 67 - Panelboards

7. UL 50 - Cabinets and Boxes

8. Fed. Spec. W-P-115C

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver in 35 inch maximum width or depth (or dimension required to fit section through doors), individually wrapped for protection and mounted on shipping skids.

B. Accept distribution panelboards on site. Inspect for damage.

C. Store in a clean, dry space designated by OAR. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with NEMA PB 1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to distribution panelboard internal components, enclosure, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA PB 1 service conditions during and after installation of distribution panelboards.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated and comply with instructions by manufacturer.

1.11 MAINTENANCE MATERIALS

A. Provide two of each key (where applicable).

B. Provide two fuse pullers (where applicable).

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D (Basis of Design), Eaton or approved substitutions.

2.2 GENERAL

A. Distribution Panelboards shall have circuit breaker branch protective devices complying with NEMA PB1 as a minimum requirement. Panelboards shall be NEMA I and shall meet Underwriter's Laboratories enclosure requirements for service conditions.

B. Distribution panelboards shall have UL label affixed, unless special construction prohibits and no labeling or listing is available.

C. Short-Circuit Rating:

1. Minimum integrated short circuit rating: 22,000 amperes rms symmetrical for 240 volt; 35,000 amperes rms symmetrical for 480 volt. Bus shall be braced for minimum capacity equal to or greater than the lowest breaker symmetrical interrupting capacity. Minimum short circuit rating shall be increased to meet the following requirements:

a) Individual C.B. AIC Rating shown on panel schedules indicate lowest AIC rating allowed for individual circuit breaker in panel.

b) Circuit breakers shall be based on a fully rated system.

c) Circuit breaker types are not shown or called for. The contractor must provide breakers in panel or feeder breakers in upstream breakers to comply with the required AIC specified.

d) Distribution panelboards to be freestanding type construction unless specifically specified otherwise.

2. Short-Circuit Rating Label:

a) Panelboards shall be labeled with a UL short-circuit rating.

b) Series ratings shall not be used to achieve short circuit ratings.

D. Enclosure:

1. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

2. Enclosures shall be provided with blank ends.

3. Where indicated on the drawings, branch circuit panelboards shall be column width type.

4. Regulatory Requirements:

a) NEMA PB 1, Type 1, Interior dry locations.

b) NEMA BP 1 Type 3R, Interior damp locations

c) NEMA PB 1, Type 4X stainless steel watertight, Exterior locations including those notes on drawings to be NEMA 3R

d) NEMA PB 1, Type 4X stainless steel watertight, interior wet locations, and washdown areas, regardless of that noted on drawings.

e) UL 50

2.3 DISTRIBUTION PANELBOARDS

A. Description: NEMA PB 1 with electrical ratings and configurations as indicated.

B. Overcurrent Devices: Panel mounted.

C. Bus Material: Copper standard size.

D. Bus Connections: Bolted, accessible from front for maintenance.

E. Ground Bus: Extend length of board.

F. Molded Case Circuit Breakers - 1200A and Below:

1. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.

3. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings and as specified herein.

4. Circuit breakers 225 ampere and below shall have thermal-magnetic trip units and inverse time-current characteristics.

5. Circuit breakers above 225 ampere shall have microprocessor based programmable RMS sensing trip units.

6. Ground fault protection shall be provided where indicated.

7. Where indicated circuit breakers shall be current limiting.

8. Where indicated provide UL listed circuit breakers for applications at 100% of their continuous ampere rating in their intended enclosure.

G. Programmable Trip Units: (Circuit Breakers Above 225 Ampere)

1. Each circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached Basis of Design is Eaton type OPTIM 1050.

2. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed-type as indicated. Rating plugs shall be interlocked

so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

3. System coordination shall be provided by the following microprocessor-based programmable time/current curve shaping adjustments:

   a) Programmable long-time pickup settings in 1% increments, with +/- 5% band tolerance

   b) Programmable long-time delay with selectable l2t or l4t curve shaping.

   c) Programmable short-time settings (dependent on long-time setting) in 1% increments, with +/- 5% band tolerance.

   d) Programmable short-time delay with selectable flat or l2t curve shaping.

   e) Programmable instantaneous pickup settings in 1% increments.

   f) Programmable ground fault pickup settings trip or alarm in 1% increments.

   g) Programmable ground fault delay with selectable flat or l2t curve shaping.

4. The microprocessor-based trip unit shall have a powered/unpowered selectable thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

5. When the instantaneous setting has been deselected, a selectable discriminator circuit shall be provided to prevent the breaker being closed and latched on to a faulted circuit.

6. Internal ground fault protection or alarm settings, if specified, shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

7. The trip unit shall have an information system that utilizes battery backed up LEDs to indicate mode of trip following an automatic trip operation. The indication of the mode of trip shall be retained after an automatic trip. The LEDs shall be complemented by trip event information stored in non-volatile memory after a trip event. A trip reset button shall be provided to turn off the LED indication and reset the memory after an automatic trip. A test pushbutton shall energize an LED to indicate battery status.

8. A red LED shall be provided on the face of the trip unit and pre-set to flash on and off when an adjustable high-load level is exceeded. A time-delay shall be provided to avoid nuisance alarms. The microprocessor-based trip units shall be capable of monitoring the following data:

   a) Instantaneous value of phase, neutral and ground current.

   b) Minimum and maximum current values.

   c) Average demand current.

   d) System diagnostic information such as alarms and cause of trip.

   e) Approximate level of fault current that initiated an automatic trip operation.

9. The trip unit shall contain test capability. Testing shall be carried out by using a hand-held programmer, a breaker interface module or a remote computer to select the values of test current within a range of available settings. The basic protection functions shall not be affected during test operations. The breaker may be tested in either the "Trip" or "No Trip" test mode.

10. A hand-held programming unit shall be provided to set/change the network communication breaker address for each device, set the stem baud rate, distribution frequency, display breaker information, and display monitored values. In addition, provide password protection for programming time/current set points and to perform functional testing of phase and ground trip characteristics. The programmer shall be self-powered by an internal battery. Provide two (2) hand-held programming units. Contractor shall submit Spare Parts Certification Memo certifying two hand-held programming units have been turned over to the Owner.

11. The monitored data shall be displayed by a hand-held programmer, a breaker interface module and a remote computer.

12. Circuit breakers, 1200 ampere frame and below, shall be provided with a 24 volt DC power supply mounted within the assembly. In addition, provide a minimum of one (1) auxiliary switch and one (1) bell alarm, each with form C contacts in each breaker. Provide additional auxiliary switches, bell alarms, shunt trips, and undervoltage releases where indicated on the drawings.

13. The trip unit shall be capable of two-way communication via a network twisted pair for remote monitoring and control. The trip unit shall be provided with an address register for identification on the network. All monitored values shall be transmittable over the network.

14. The trip unit shall include zone interlocking capability for the short-time delay and ground fault delay trip functions for improved system coordination. The zone interlocking system shall restrain the tripping of an upstream circuit breaker, and allow the circuit breaker closest to the fault to trip with no intentional time delay. In the event that the downstream breaker does not trip, the upstream breaker shall trip after the pre-set time delay. Factory wire zone interlocking system for breakers within each assembly.

15. Molded case circuit breakers shall be provided with a potential transformer, suitable for operation up to 600 volts. The potential transformer shall be mounted externally to the circuit breakers and provided with a dielectric disconnect fuse.

16. For enhanced system analysis, the following additional parameter values shall be monitored:

    a) Peak demand (kW)

    b) Present demand (kW)

    c) Reverse energy (kWh)

    d) Forward energy (kWh)

    e) Total energy (kWh)

    f) Power factor

g) Percentage harmonic content

h) Total Harmonic Distortion (THD).

H. Power Monitoring

1. Panel mounted meter (incoming metering device)

a) All Distribution Panelboards 800 Amperage and larger shall be provided with a Eaton PXM-2280 (or approved substitution) microprocessor based sub-meter complete with C.T.'s and communication to panel mounted monitor/display unit to provide the following data: Volts, amps, watts, watt-hour, vars, power factor, frequency, demand watts.

b) Provide all interface cabling and connections.

2. Panel mounted breaker monitor/display unit:

a) All distribution panelboards 800 Amperage and larger shall be provided with a Breaker Interface Module Unit to monitor/display data from incoming metering device and each branch breaker's trip unit 250 Amperage or larger.

b) Provide all interface cabling and connections.

3. All breakers over 225 ampere and all meters are to be connected to main PowerNet computer (PC) in GOAA's Electrical Maintenance Office and the Central Plant operators station via appropriate device, equipment, cables, hubs, switches, converters, etc.

I. Ground Fault Sensor (where called for on drawings): Zero sequence of ground return type.

J. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

K. Enclosure: Type 1 - General Purpose for interior locations. Type 2 - Rain tight for damp locations.

1. Align sections at front and rear.

2. Finish:

a) Interior dry locations: Manufacturer's standard light gray enamel over external Interior surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

b) Damp locations: Coat interior and exterior of enclosure with rust inhibiting primer and paint over with epoxy paint.

c) Exterior, wash-down areas, and Interior wet locations: NEMA 4X stainless steel, watertight.

2.4 DISTRIBUTION ENTRANCE EQUIPMENT

A. Panelboards used as service entrance equipment shall be listed and labeled by UL for use as service equipment.

**PART 3 - EXECUTION**

3.1 PREPARATION, INSPECTION, EXAMINATION

A. Verify that surface is suitable for panelboard installation. Do not install NEMA 1 equipment until building has been “dried-in” stage.

B. Examine area to receive panelboard to assure adequate clearance.

C. Verify National Electrical Code clearances will be maintained after installation. Rework equipment locations as required to provide Electrical code clearances.

D. Start Work only after unsatisfactory conditions have been corrected.

E. Submit coordination drawings of all electrical rooms, showing all electrical (and mechanical) equipment. Comply with requirements of Section 26 05 01.

3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1. Install all panelboards and distribution panelboard enclosures in accordance with the manufacturer's written instructions, NECA's "Standard of Installation", the applicable requirements of the National Electrical Code, and recognized industry practices.

B. Install panelboards plumb. Install recessed distribution panelboards flush with wall finishes. Provide supports in accordance with Section 26 05 29.

C. Panelboards and terminal cabinets shall be provided with structural framing located within gypsum board partition. All enclosures shall be firmly anchored to walls and supporting structures (where used) using appropriate hardware. Provide supporting (unistrut type) channels on walls constructed of gypsum board or where otherwise necessary to provide a mechanically secure and permanent installation. Attach channels to framing provided within gypsum board partitions

D. Install enclosures so that the top is 6'-6" above finished floor. Where the size of the enclosure is such that the top cannot be installed at 6'-6", the top of the enclosure shall be kept as low as possible.

E. Provide filler plates for unused spaces in distribution panelboards.

F. Provide spare conduits out of each recessed distribution panelboard to an accessible location above ceiling. Minimum spare conduits: 4 empty 1 inch. Identify each as SPARE.

G. Install distribution panelboards so that proper working clearances shall be maintained at every distribution panelboard location.

H. Clean the interior of each distribution panelboard before installing conductors. At all times, keep the interior trim and exterior surfaces of the distribution panelboard free of rust and debris. Repaint finishes if necessary.

I. Coordinate all raceways and conductors with their respective distribution panelboards so that all connections and conductors routing present an orderly appearance. Conductors in the distribution panelboards shall be laced and arranged in orderly manner.

J. Provide a separate neutral conductor for each GFI breaker. These shall not be combined to serve more than 1 circuit, even where on different phases. Increase plan indications of conductors for neutral wires required, as necessary.

K. Provide 3" concrete housekeeping pad.

L. Provide and install separate 120 volt, 20 AMP circuit complete with circuit breaker, transformer, conduit, and wire as required to power any shunt-trip function specified.

M. Conduit or piping systems that contain water or liquid of any kind shall not be installed over the top of any electrical equipment, transformers, racks, cabinets, or enclosures without prior written approval from the Owner.

3.3 MONITORING/METERING

A. Provide/install all components, wiring, cable (fiber optic and copper), raceways, hubs, switches, patch panels modules, pc cards, communication network devices, converters, etc. as required to connect monitoring/metering equipment in each panelboard (provided with monitoring/metering) to GOAA's PowerNet Computer (PC) located in Electrical Maintenance Shop/Office and in the Central Plant's operators station.

B. Provide/install all software, programming, etc. to facilitate installation and monitoring of all monitor/meter equipment on GOAA's selected PowerNet PC System.

C. Integrate all new equipment provided under this contract into existing software including programming/changes required to computer screens, program trending, program event logging, etc.

D. Coordinate with GOAA final approval of screens, trending, and event logging requirements and program system accordingly.

E. All revisions to software, programming, etc is to be by manufacturer of software.

3.4 IDENTIFICATION

A. Refer to Section 26 05 53.

B. Provide engraved plastic nameplates under the provisions of 26 05 53.

3.5 FIELD QUALITY CONTROL

A. Measure steady state load currents at each distribution panelboard feeder; rearrange circuits in the distribution panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

C. All circuits shall be operated to establish a good working order and checked for shorts.

D. All panel directory circuit numbers shall be checked to verify accuracy of the number.

E. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each, at test voltage of 1000 volts; minimum acceptable value for insulation resistance is 2 megohms.

F. Check tightness of accessible bolted bus joints using calibrated torque wrench.

G. Physically test key interlock systems to insure proper function.

H. Tests:

1. Test Distribution panelboards and distribution panelboard feeders per requirements of Section 26 08 10.

2. Feeder conductors shall be checked by approved means to establish the absence of shorts to ground; insulation value, etc. and the result recorded and submitted to the Designer.

3. Submit Conductor Insulation Resistance Test per requirements of Section 26 08 10.

4. Submit Tabulation Data Voltage and Amperage Readings per requirements of Section 26 08 10.

I. Equipment Checkout:

1. When requested by Designer provide (during construction):

a) Inspection of equipment by authorized equipment manufacturer technician complete with submittal of statement of findings by technician, and providing any adjustments deemed necessary for a complete and operating system.

b) Submit Equipment Checkout Memo per Section 26 08 10.

3.6 ADJUSTING

A. Adjust all operating mechanisms for free mechanical movement.

B. Tighten bolted bus connections in accordance with manufacturer’s instructions.

C. Adjust circuit breaker trip and time delay settings to values per manufacturer’s recommendation.

## END OF SECTION 26 24 16.13

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# SECTION 26 27 16 – ELECTRICAL CABINETS AND ENCLOSURES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of cabinets and enclosures.

1.3 DESCRIPTION

A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:

1. Hinged cover enclosures.

2. Cabinets.

B. Cabinets and enclosures are to include:

1. Terminal blocks,

2. Mounting panel,

3. Ground bus/bar, and

4. All accessories as required for a complete and operating system.

C. Provide cabinets and enclosures for all systems specified in Division 26.

1.4 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

2. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.

3. ANSI/NFPA 70 - National Electrical Code.

1.5 SUBMITTALS

A. Submit Product Data: Provide manufacturer's standard data for enclosures and cabinets.

B. Submit Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

C. Submit shop drawings on all cabinets and enclosures showing:

1. Covers.

2. Dimensions - inside and out.

3. Gauge of metal.

4. Manufacturer.

5. Terminal mounting plate, construction, etc.

6. Ground bus/bar.

1.6 EXTRA MATERIALS

A. Provide two keys for each type of lock.

## PART 2 - PRODUCTS

2.1 GENERAL

A. Unless specifically called for otherwise on contract drawings, provide "CABINETS" as specified herein for terminal cabinets mounted indoor. Similarly, provide "HINGED COVER ENCLOSURES" as specified herein for terminal cabinets mounted outdoors or in locations other then NEMA 1 locations. Also, provide "HINGED COVER ENCLOSURES" for locations where size required is not available in "CABINET" construction, or if specifically specified as "enclosure" on contract documents.

B. Size.

1. Dimensions of cabinets and enclosures shall meet the dimensions shown on drawings, dimensions required by NEC, or dimensions sized as required to facilitate all equipment/connections involved installation, whichever is largest.

2. Coordinate sizes required and assure that equipment cabinets or enclosures will house and facilitate proper installation and access to equipment.

C. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring or where wiring from separate systems of Normal and Emergency Power are required to be in one enclosure.

D. Provide accessory feet or mounting brackets for free-standing equipment.

2.2 HINGED COVER ENCLOSURES

A. Construction:

1. Interior Dry Locations: NEMA Type 1 (unless otherwise noted), steel.

2. Exterior and Interior Wet Locations: NEMA Type 4X: Stainless steel.

B. Covers: Continuous hinge.

C. Enclosure Finish:

1. NEMA 1: manufacturer's standard metallic gray enamel over phosphatized surfaces.

2. NEMA 4X: Stainless steel.

D. Lock/handle.

1. Provide key lock handle on all enclosures mounted in areas that are not dedicated electrical or mechanical rooms. Enclosures installed in electrical rooms are not required to be lockable.

E. Interior mounting plate.

1. Each enclosure is to have interior mounting plate/panel for mounting terminal blocks and electrical components.

2. Plate/panel is to be metal.

F. Ground bus/bar.

1. Each enclosure housing surge suppression equipment or other equipment shall have "local" ground bar/bus installed. See Article "Local Ground Bus/Bar".

2.3 CABINETS

A. Construction: Specified gauge steel with removable enwalls.

B. Finish:

1. Boxes:

a) Surface mounted: Gray baked enamel.

b) Flush mounted: Galvanized steel.

2. Fronts: Gray baked enamel.

C. Fronts:

1. Electrical or mechanical room locations: screw cover with hinged door and flush handle or as noted below.

2. Other locations: mono-flat with concealed trim clamps, concealed hinges, flush lock lockable handle, and custom color finish in interior public areas to match mounting surface.

3. Flush or surface type as shown or called for on contract documents.

D. Interior mounting plate.

1. Each enclosure is to have interior mounting plate/panel for mounting terminal blocks and electrical components.

2. Panel/plate shall be metal.

E. Ground bus/bar.

1. Each cabinet housing surge suppression equipment or other equipment shall have "local" ground bar/bus installed. See specification for "Local Ground Bus/Bar" included within this section.

2.4 TERMINAL BLOCKS

A. Terminal Blocks: ANSI/NEMA ICS 4.

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Provide ground bus terminal block, with each connector bonded to enclosure.

2.5 LOCAL GROUND BUS/BAR

A. Size to handle #6 through #14 AWG copper ground wire.

B. Length as required for circuits.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify that surfaces are ready to receive Work.

3.2 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and cabinets plumb. Anchor securely to wall and structural supports at each corner.

C. Install cabinet fronts plumb.

D. Install per N.E.C. and as required for proper clearance. Coordinate with panels.

E. Provide and install terminal cabinets as shown on drawings or as required by the National Electrical Code (NEC).

F. Provide terminal cabinets wherever required for a complete and operating distribution system whether shown on drawings or not.

G. Install local ground bus/bar in each terminal cabinet/enclosure that houses surge suppression equipment or other equipment and bond to cabinet enclosure via mounting screws or #6 AWG copper ground wire.

H. Ground local ground bus to "SYSTEMS" ground bus/bar with minimum #6 AWG copper ground wire. Increase size if so required on drawings.

I. Install enclosures. Identification of cabinets is required. Phenolic labels with voltage, circuit, panel, fed from, location of source, location of load.

## END OF SECTION 26 27 16

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# SECTION 26 27 26 - WIRING DEVICES

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of wiring devices.

1.3 DESCRIPTION

A. Provide and install all equipment, labor, material, accessories, and mounting hardware for a complete and operating system for the following:

1. Wall switches.

2. Wall timer switches

3. Receptacles.

4. Device plates and decorative box covers.

1.4 SUBMITTALS

A. Submit Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations including all types of wiring devices, plates and engraving.

B. Submit Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years experience.

1.6 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

B. Conform to the requirements of the following:

1. ANSI/NFPA 70 - National Electrical Code

2. NEMA WD 1 - General Purpose Wiring Devices.

3. NEMA WD 5 - Wiring Devices, Special Purpose

4. NEMA WD 6 - Wiring Device Configurations.

1.7 EXTRA MATERIALS

A. Provide a minimum of two (2) screw drivers of each type of tamper proof screw used on project. Turn over to OAR. Include receipt in O&M manual.

## PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall be Specification Grade as minimum.

B. General purpose wiring devices shall meet NEMA standard WD-1, wiring devices, general purpose. Special purpose devices shall conform to the requirements of NEMA standard WD-5, wiring devices, special purpose.

C. All wiring devices shall bear UL labels.

D. All devices of one type shall be by the same Manufacturer.

1. "Hazardous Location" and special purpose devices as may not be available from the same manufacturer shall constitute the only exception to this requirement of single source.

E. Corrosion resistant devices shall be as specified for normal usages, and fabricated of yellow color melamine plastic. Where "Weatherproof" type is indicated for exterior or wet locations, provide matching self-closing cover, with gasketed seals at plate/wall junctions and for cover.

1. Provide factory packaged wiring devices having high impact strength molded plastic bodies.

F. Except where specifically required, the use of interchangeable type or combination switch-receptacle-pilot devices are not acceptable.

2.2 WALL SWITCHES

A. General:

1. Snap switches for general use shall be maintained contact types, and shall be single-pole, double-pole, three-way, or four-way as required for the specific switching arrangements shown on the drawings. They shall be quiet tumbler operation types, having silver alloy contacts, and meeting all NEMA performance standards. Color to match plates unless specifically noted otherwise.

2. Switches shall be toggle or key-operated types, as indicated on the drawings. All key-operated switches shall be keyed alike.

3. Where switches are denoted as having pilot lights, pilot lights shall glow when the switches are "ON". Provide pilot light switch with lamp and miniature step-down transformer. The pilot light shall have a red lens, and the lamp shall be long-life type.

4. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be amber. All units shall be front relampable.

5. Snap switches installed in hazardous locations shall be UL listed for the type of location (class and division).

6. Switches connected to emergency power shall have red lighted handles which shall illuminate when the switches are "Off".

7. Voltage and ampere rating of switches shall be marked on switch, and shall conform to voltage of system to which applied.

8. Switches shall have back and side wired screw pressure terminals.

B. Description: NEMA WD 1, heavy-duty, AC only general-use snap switch.

C. Voltage Rating: 120-277 volts, AC.

D. Current Rating: 20 amperes minimum.

E. Ratings: Match branch circuit and load characteristics.

2.3 WALL TIMER SWITCHES

A. Voltage: 120 volts or as required to match application.

B. Power Rating: Match load shown on Drawings; 600 Watts minimum.

C. Accessory Wall Switch:

1. Match appearance.

2. Same manufacturer and style as timer switch.

2.4 RECEPTACLES

A. General:

1. All receptacles shall be of standard NEMA configuration, as indicated on the drawings, and shall comply with the respective ANSI C73 series standard for the NEMA configuration. Color to match plates unless specifically noted otherwise.

2. Duplex receptacles shall have integral UL listed self-grounding clips. Similar, single receptacles shall be provided for plug-in connections of industrial fluorescent light fixtures on the same switching circuit. Receptacle face to be impact resistant nylon.

3. Weatherproof duplex receptacles shall be provided in all exterior locations, and shall be Ground Fault Circuit Interrupting (GFCI) types, with weatherproof stainless steel cover plates.

4. Special purpose receptacles for specific equipment shall be grounding types, having the number of poles, voltage and ampere ratings, and NEMA configurations required by the equipment. For each special purpose receptacle, provide an identical mating plug equipped with cord grip, secured to cord.

5. Duplex receptacles shall have back and side wired screw pressure terminals.

6. Receptacles to be installed in shower rooms, locker rooms, toilet rooms, janitors closets, exterior, elevator pit and machine rooms, escalator pits, within six (6) feet of a sink, and other areas as required by NEC, and OSHA Standards shall be ground fault circuit interrupting (GFCI) type, whether specified or not.

7. Receptacles installed for water coolers shall be GFCI type, or a single receptacle as permitted by NEC.

B. Description: NEMA WD 1; heavy-duty general use receptacle.

C. Configuration: NEMA WD 6; heavy-duty, general use type as specified and indicated.

D. Convenience Receptacle: Type 5-20.

E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter, and automatic “self-testing feature” to meet regulatory requirements.

2.5 COVER PLATES

A. All wiring devices shall be provided with standard size one-piece cover plates of suitable configuration for the number and type of devices to be covered.

B. Metallic cover plates shall be used in interior spaces, except as noted below, and shall be fabricated of corrosion-resistant #302 stainless steel, having a nominal thickness of .04", and a brushed finish. Screws securing the plates shall have flush (when installed) heads with finish to match plates. Metallic cover plates shall meet all requirements of the National Electrical Code and Federal Specifications.

C. Cover plates for switches located in corrosive atmospheres (where vaporproof is not indicated) shall consist of a one piece neoprene boot with matching presswitch.

D. Cover plates for exterior receptacles shall be gasketed covers with hinge allowing plug and cord to be plugged in and activated with cover closed..

E. Cover plate engraving, where required, shall be accomplished by cover plate manufacturer in accordance with instructions given on the drawings. Metallic plates and nylon plates in ivory, beige, gray, and white shall be engraved with black fill. Red, brown, and black nylon plates shall be engraved with white fill.

F. Plates for devices connected to emergency power shall be as specified for devices connected to normal circuits, but shall be engraved reading "Emergency", see drawings for other engraving requirements.

G. Plates for devices connected to computer power panels shall be engraved reading “Computer”. Devices connected to emergency computer power panels shall be red in color.

H. Plates for devices connected to UPS power systems shall be as specified for devices connected to normal circuits, but shall be engraved reading "UPS POWER", see drawings for other engraving requirements.

I. Unless specifically noted otherwise in specs or on drawings all outlets for telephone and other communications and data systems shall be provided with standard size one-piece cover plates having a minimum 3/4 inch diameter, with bushing, in the center unless specifically noted otherwise. Where telephone conductors are installed, plates shall contain telephone type, polarized plug-in receptacles.

J. Device plates located in secure areas, as noted on drawings, shall have security wall plates (10 gauge) with 12 gauge galvanized steel backplate. All device plates shall have tamperproof screws.

2.6 COLOR

A. Wiring devices connected to normal power shall be gray unless specifically noted otherwise.

B. All devices and coverplates in paneled walls shall have finish to match paneling.

C. Devices connected to emergency power shall be red color. (Including devices connected to emergency computer power panels).

D. Devices connected to separate computer power panels shall be black in color.

E. Modify any given catalog numbers as required to procure devices and plates of the proper color.

F. Devices connected to UPS systems shall be orange (isolated ground).

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and will be completely covered by wall plates.

C. Verify floor boxes are adjusted properly.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. In general. lighting control switches shall be located at the lock/strike plate side of door(s). If the drawings indicate otherwise, issue a request for clarification prior to rough-in.

E. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

F. Do not share neutral conductor on load side of dimmers.

G. Install receptacles with grounding pole on bottom.

H. Where 2 or more switches or receptacles are to be installed adjacent to one another, provide a multi-gang coverplate. Provide proper NEC barriers in boxes which serve devices for both the Normal and Emergency Systems or a combined system voltage of 480 volt.

I. Provide device coverplates for every device installed. Cover plates shall be installed so that they appear straight with no gaps between plate edges and the wall. Maintain vertical and horizontal to within 1/16 of an inch.

J. In finished areas, provide same type of plate for all surface mounted devices as for recessed mounted devices.

K. In any room, where new and existing construction is present, all receptacles, switches, and coverplates which are existing to remain shall be changed, to match new work.

L. Wiring devices shall not be installed in exposed masonry until cleaning of masonry with acids has been completed.

M. All receptacles and switches shall be grounded by means of a ground wire from device ground screw to outlet box screw and branch circuit ground conductor. Strap alone will not constitute an acceptable ground.

N. All wiring devices, relays, contactors, pushbuttons, selector switches, pilot lights, etc. shall be installed in approved enclosures rated for the appropriate NEMA classified environment.

O. All devices shall be installed so that only one wire is connected to each terminal.

P. Once construction is substantially completed, replace all damaged, burned, or scorched wiring devices.

Q. Receptacles shown to be floor mounted shall be installed in floor boxes (with coverplates) which are approved for this use.

R. Connect wiring devices by back wiring conductor into compression terminal.

S. Install protective rings and split nozzle on active flush cover service fittings.

3.4 NEUTRAL CONDUCTOR CONNECTIONS

A. At each receptacle "in" and "out" phase and neutral conductors shall have an additional conductor “pigtail” for connection to device. The practice of "looping" conductors through receptacle boxes shall not be acceptable.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes to obtain specified mounting heights.

3.6 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

## END OF SECTION 26 27 26

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# SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 – GENERAL

1.1 DESCRIPTION OF WORK INCLUDED

A. Fusible switches.

B. Non-fusible switches.

C. Molded-case circuit breakers (MCCBs).

D. Enclosures.

1.2 REFERENCES

A. In accordance with Reference Standards and Regulatory Requirements all equipment and materials associated with Division 26 sections shall comply with applicable requirements of ANSI, CSA, NEC, NEMA, and UL standards.

B. Coordinate with Division 23 for disconnect switches for mechanical equipment. Provide all other disconnect switches required for a complete operating system.

1.3 SUBMITTALS FOR REVIEW

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1.4 SUBMITTALS AT PROJECT CLOSE-OUT

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals include the following:

1. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

## PART 2 – PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturer: Same as panelboards.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three (3) padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors. Provide on all switches.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors. Provide in all switches that are fed with a feeder/branch circuit that contains a neutral.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Auxiliary Contact Kit: Two (2) NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Provide as required.

5. Lugs: Mechanical type, suitable for number, size, and conductor material.

6. Service-Rated Switches: Labeled for use as service equipment. Provide for each building that the first overcurrent protective device is a switch.

2.2 NON-FUSIBLE SWITCHES

A. Manufacturer: Same as panelboards.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three (3) padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturer: Same as panelboards.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Electronic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I2t response.

E. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

## PART 3 – EXECUTION

3.1 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.2 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the work.

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

3.3 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Install fuses in fusible devices.

C. Comply with NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

**END OF SECTION 26 28 16**

# SECTION 26 32 13 - INDOOR ENGINE GENERATOR

## PART 1 - GENERAL

### 1.1 REFERENCES AND STANDARDS

The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below:

• CSA 282

• CSA 100

• EN61000-6

• EN55011

• FCC Part 15 Subpart B

• ISO8528

• IEC61000

• UL508

• UL2200

• UL142

• Designed to allow for installed compliance to NFPA 37, NFPA 70, NFPA 99 and NFPA 110

### 1.2 RELATED SECTIONS

Section 26 36 23 – Bypass Isolation Automatic Switch

Div. 23 - Mechanical

### 1.3 WORK INCLUDED

#### 1.3.1 Installation

The work includes supplying and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories and automatic transfer switches specified under a separate section.

#### 1.3.2 Fuel System

The contractor shall provide Diesel fuel for the completion of all testing.

#### 1.3.3 System Test

A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.

#### 1.3.4 Requirements, Codes and Regulations

The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a MANUFACTURER who has 10 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

## 1.4 SUBSTITUTION

A. Indoor diesel fuel generator basis of design is Caterpillar. Alternate manufactures shall submit a request and include a written list of deviations from this specification to be considered for approval.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. The manufacturer listed above is not relieved from meeting these specifications in their entirety. Equivalent products determined by the Engineer to be in full compliance with the specification may be acceptable.

C. All power and control equipment as specified in the contract documents shall be considered an integral part of the Standby Power System and shall be supplied by the Standby Power System Supplier. The Standby Power System Supplier shall be responsible for coordination of the entire Standby Power System to provide for unit responsibility.

## 1.5 SYSTEM RESPONSIBILITY

#### 1.5.1 Requirements, Codes and Regulations

The equipment supplied and installed shall meet the requirements of NEC and all-applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

#### 1.5.2 Automatic Transfer Switch

The automatic transfer switch(es) specified in Section 26 36 23 shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

## 1.6 WARRANTY

#### 1.6.1 Generator Set Warranty

The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair.

## 1.7 SUBMITTALS

Engine-generator submittals shall include the following information:

A. Factory published specification sheet.

B. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, etc.

C. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.

D. Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.

E. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

F. Wiring Diagrams: Control interconnection, Customer connections.

G. Weights and dimensions, layout, and stub-up locations of electrical and fuel systems to be used for concrete pad design.

H. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, control panel, and remote alarm indications.

I. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.

J. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.

K. Generator resistances, reactances and time constants.

L. Generator locked rotor motor starting curves.

M. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads.

N. Manufacturer's and dealer's written warranty.

## PART 2 - PRODUCT

### 2.1 GENERAL REQUIREMENTS

#### 2.1.1 Generator set Requirements

The generator set shall be Standby Duty rated at 300 ekW, 375.0 kVA, 1800 RPM, 0.8 power factor, 208V, 3-Phase, 60 hertz, including radiator fan and all parasitic loads. The generator emergency power supply system (EPSS) shall be Level 1, Class 96, and Type 10. Generator set shall be sized to operate at the specified load at a maximum ambient of 100F and altitude of 200 feet.

#### 2.1.2 Material and Parts

All materials and parts comprising the unit shall be new and unused.

#### 2.1.3 Engine

The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating

compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW / bHP rating. Emissions requirements / certifications of this package: EPA TIER II

#### 2.1.3.1 Engine Governing

The engine governor shall be an electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 6 RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

## 2.2 GENERATOR

### 2.2.1 Generator Specifications

The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The excitation system shall enable the alternator to sustain 300% (250% for 50Hz) of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings).

### 2.2.2 Voltage Regulator

#### 2.2.2.1 Automatic Voltage Regulator

The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid-state design, which includes electronic voltage buildup, over-excitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed. Voltage regulation shall be selectable to be either volts per hertz or by load adjustment module.

### 2.2.3 Motor Starting

Provide locked rotor motor starting capability of 811.7 skVA at 30% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

## 2.3 CIRCUIT BREAKER

### 2.3.1 Circuit Breaker Specifications

Provide a generator mounted 3 Pole circuit breaker, molded case, NEMA 1/IP22. Breaker shall utilize a solid-state trip unit. The breaker shall be UL/CSA Listed of IEC construction and connected to

engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

Standard Features:

- Molded case thermal magnetic trip breaker sized for full unit output rating
- Neutral connection sized for full product ratings.
- Ground connection in the customer power wiring section

## 2.4 CONTROLS – GENERATOR MOUNTED

Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via SAE J1939.

### 2.4.1 Environmental

The generator set control shall be tested and certified to the following environmental conditions:

A. –40°C to +70°C Operating Range

B. 100% condensing humidity, 30°C to 60°C

C. IP22 protection for rear of controller; IP55 when installed in control panel

D. 5% salt spray, 48 hours, +38°C, 36.8V system voltage

E. Sinusoidal vibration 4.3G's RMS, 24-1000Hz

F. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)

G. Shock: withstand 15G

### 2.4.2 Functional Requirements

The following functionality shall be integral to the control panel.

A. The control shall include a minimum 33 x 132 pixel, 24mm x 95mm, positive image, transflective LCD display with text-based alarm/event descriptions.

B. The control shall include a minimum of 3-line data display

C. Audible horn for alarm and shutdown with horn silence switch

D. Standard ISO labeling

E. Multiple language capability

F. Remote start/stop control

G. Local run/off/auto control integral to system microprocessor

H. Cooldown timer

I. Speed adjusts

J. Lamp test

K. Emergency stop push button

L. Voltage adjusts

M. Voltage regulator V/Hz slope – adjustable

### 2.4.3 Digital Monitoring Capability

The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

**Engine**

A. Engine oil pressure

B. Engine oil temperature

C. Engine coolant temperature

D. Engine RPM

E. Battery volts

F. Engine hours

G. Engine crank attempt counter

H. Engine successful start counter

I. Service maintenance interval

J. Real time clock

K. Engine exhaust stack temperature

L. Engine main bearing temperature

**Generator**

A. Generator AC volts (Line to Line, Line to Neutral and Average)

B. Generator AC current (Avg and Per Phase)

C. Generator AC Frequency

D. Generator kW (Total and Per Phase)

E. Generator kVA (Total and Per Phase)

F. Generator kVAR (Total and Per Phase)

G. Power Factor (Avg and Per Phase)

H. Total kW-hr

I. Total kVAR-hr

J. % kW

K. % kVA

L. % kVAR

M. Generator bearing temperature

N. Generator stator winding temperature

**2.4.4 Alarms and Shutdowns**

The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

**Engine Alarm/Shutdown**

A. Low oil pressure alarm/shutdown

B. High coolant temperature alarm/shutdown

C. Loss of coolant shutdown

D. Overspeed shutdown

E. Overcrank shutdown

F. Emergency stop shutdown

G. Low coolant temperature alarm

H. Low battery voltage alarm

I. High battery voltage alarm

J. Control switch not in auto position alarm

K. Battery charger failure alarm

L. Low Coolant Level

**Generator Alarm/Shutdown**

A. Generator phase sequence

B. Generator over voltage

C. Generator under voltage

D. Generator over frequency

E. Generator under frequency

F. Generator reverse power (real and reactive)

G. Generator overcurrent

**Voltage Regulator Alarm/Shutdown**

A. Loss of excitation alarm/shutdown

B. Instantaneous over excitation alarm/shutdown

C. Time over excitation alarm/shutdown

D. Rotating diode failure

E. Loss of sensing

F. Loss of PMG

**2.4.5 Inputs and Outputs**

**Programmable Digital Inputs**

The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

**Programmable Relay Outputs**

The control shall include the ability to operate programmable relay output signals, integral to the controller. The output relays shall be rated for 2A @ 30VDC and consist of six (6) Form A (Normally Open) contacts and two (2) Form C (Normally Open & Normally Closed) contacts.

**Programmable Discrete Outputs**

The control shall include the ability to operate two (2) discrete outputs, integral to the controller, which are capable of sinking up to 300mA.

**2.4.6 Maintenance**

All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control

A. Engine running hours display

B. Service maintenance interval (running hours or calendar days)

C. Engine crank attempt counter

D. Engine successful starts counter

E. 40 events are stored in control panel memory

F. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 7 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:

1. Day of week

2. Time of day to start

3. Duration of cycle

**2.4.7 Remote Communications**

The control shall include Modbus RTU communications as standard via RS-485 half duplex with configurable baud rates from 2.4k to 57.6k.

**2.4.8 Annunciation**

**Remote Annunciator (NFPA 99/110, CSA 282)**

Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.

A. The annunciator shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.

B. Ability to be located up to 500 ft from the generator set

C. The annunciator shall provide remote annunciation of all points listed below:

1. Over-crank

2. Low coolant temperature

3. High coolant temperature warning

4. High coolant temperature shutdown

5. Low oil pressure warning

6. Low oil pressure shutdown

7. Overspeed

8. Low coolant level

9. EPS supplying load

10. Control switch not in auto

11. High battery voltage

12. Low battery voltage

13. Battery charger AC failure

14. Emergency stop

15. Spare (or ATS Remote Start wiring failure)

## 2.5 COOLING SYSTEM

The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110 F* ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

## 2.6 FUEL SYSTEM

The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300 degrees F and 100 psi.

## 2.7 STARTING SYSTEM

### 2.7.1 Starting Motor

A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

### 2.7.2 Jacket Water Heater

Jacket water heater shall be provided and shall be sized to ensure that genset will start within the specified time period and ambient conditions.

### 2.7.3 Batteries

Lead-acid storage batteries to be used in conjunction with the electric starting system shall be provided. The batteries shall be rated by the battery manufacturer in accordance with requirements set forth by the engine manufacturer. A fiberglass battery box with battery disconnects and necessary cables and clamps shall be provided. Wiring shall be sized as required by manufacturer for distance involved.

### 2.7.4 Battery Charger

A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

## 2.8 EXHAUST SYSTEM

### 2.8.1 Silencer/Muffler

The silencer/muffler, companion flanges, and flexible stainless-steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor as shown on the drawings. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

# PART 3- EXECUTION

## 3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

## 3.2 START-UP AND TESTING

Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:

**With reactive Load bank**: Perform a 4-hour load bank test at a 0.8 PF at full nameplate rating. Load bank, cables and other equipment required for this test to be supplied by the genset supplier.

**NFPA 110 Load Test Requirements:**

- Verify that the equipment is installed properly.
- Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
- Test all alarms and safety shutdown devices for proper operation and annunciation.
- Check all fluid levels.
- Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
- Verify proper voltage and phase rotation at the transfer switch before connecting to the load.
- Connect the generator to building load and verify that the generator will start and run all designated loads.
- The system shall be tested under full load and monitor the following readings:
    1. Oil pressure
    2. Coolant temperature
    3. Battery charge rate
    4. AC volts
    5. AC Amperes- all phases
    6. Frequency
    7. Kilowatts
    8. Ambient Temperature

### 3.3 OPERATION AND MAINTENANCE MANUALS

Provide two (2) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

### 3.4 TRAINING

Provide on-site training to instruct the owner's personnel in the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

## END OF SECTION 26 32 13

# SECTION 26 32 13.06 - OUTDOOR ENGINE GENERATOR, SUB-BASE TANK

## PART 1- GENERAL

### 1.1 GENERAL PROVISIONS

A. It is the intent of these specifications to secure, for the Owner, a new outdoor diesel engine driven generator set of the latest commercial type and design as specified herein. All material and equipment shall be new and undamaged. Systems with all components must meet or exceed requirements of NFPA 110 for Level 1 loads, UL 2200 Stationary Engine Generator Assemblies and UL 1004 Electric Motors.

B. Engine-generator supplier is required to maintain a local parts and service facility. The supplier shall furnish all installation and test supervision necessary for final acceptance in accordance with test procedures outlined in NFPA 110 for a level 1 generator. The generator set supplier shall furnish and install all equipment including sub-base fuel tank. The auxiliary power feeder and service entrance conductors and conduit shall be furnished and completely installed by electrical contractor. All generator control alarm and interlock wiring, including conduit, shall be completely furnished and installed by generator set supplier. A mini-power zone supplied by a 480V 3 phase circuit shall be supplied and installed in the generator enclosure to power generator auxiliary systems including but not limited to battery chargers, battery heaters, and block heaters, where indicated on plan drawings. Wiring from the mini-power zone to the branch loads shall be factory installed. Where a load center is not indicated, power connections to battery charger, control panel and block heater shall be individual power connections as indicated on plan drawings.

C. Warranty - Equipment furnished under this section shall be guaranteed against defective parts or workmanship under terms of the manufacturer's and dealer's standard warranties, but in no event shall it be for a period of less than two (2) years from date of initial acceptance of the system.

D. Generators to be rated as Tier II.

### 1.2 EXPERIENCE

A. The unit must be manufactured in the USA and shall be the product of a firm regularly engaged in the manufacture of engine sets and shall meet the requirements of specifications set forth herein. Units must be a standard model in regular production at the manufacturer's place of business. Engine, generator and control panels are to be serviced by the same supplier so that there shall be one source and one responsibility.

### 1.3 SHOP DRAWINGS AND PRODUCT DATA

A. Submit shop drawings and product data on the following showing compliance with the specifications:

1. Generator/Engine
2. Exhaust muffler
3. Flexible exhaust piping
4. Base and spring vibration isolators

5. Control panel

6. Main line circuit breaker

7. Copy of service contract

8. Lead-acid and fiberglass battery boxes

9. Automatic tank gauge

10. Battery charger

11. Complete load data sheet showing compliance with specified ratings.

12. Exhaust pipe rain cap.

13. Outdoor weatherproof generator enclosure

14. Base tank and isolators

15. Access stair/ handrail/ landing assembly for access into generator enclosure at enclosure doors.

B. Submittals shall clearly indicate:

1. Dimensions of unit complete with outdoor enclosure, sub-base fuel tank and pad requirements, locations of control panel, batteries, battery charger, access stair/landing assembly.

2. All pertinent data/ratings as required to show equipment meets specifications.

3. Amperage of main line breakers and their interrupting capacity. Main line circuit breakers shall have an electronic trip unit with LSI adjustability and ground fault alarm.

## PART 2 - MATERIALS/PRODUCTS/INSTALLATION

### 2.1 GENERATING SYSTEM

A. The effective site rating of the electric power generating system shall be:

1. As noted on drawings.

2. 80% power factor minimum.

3. 208 volts, 3 phase, 4 wire.

4. 60 hertz.

B. The above ratings shall be based on site conditions as follows:

1. Generator shall be used for standby emergency service to provide continuous electrical service during interruption of normal power.

2. Generator installation as shown on plans.

3. Altitude of less than 200 ft. above sea level.

4. Maximum ambient temperature of 110° F.

5. Minimum ambient temperature of 20° F.

C. Ratings of the diesel electric set shall be based on operation of the unit at rated generator RPM, when supplied with all necessary operating accessories such as radiator, the air cleaners, lubricating oil pump, fuel transfer pump, fuel injection pumps, jacket water pump, alternating current generator, exciter, and other accessories necessary to the unit.

D. Diesel engines shall be able to deliver rated power when operating on No. 2 diesel fuel having 35 degree API (16°C or 60°F) specific gravity.

E. Fuel consumption rates shall be based on fuel having a low heating value (LHV) of 42,780 kJ/kg (18,390 Btu/lb) when used at 29° (85°F) and weighing 838.9 g/l (7.001 lbs/US). The maximum fuel consumption shall be based on generator size. Refer to plans.

F. Motor Starting - Motor starting inrush shall result in maximum instantaneous voltage dip not greater than 15% as measured by light beam oscilligraph.

G. Sound Level - Mechanical sound level where all generator sets are fully loaded shall be not greater than 75 dBA at 7 m (23 ft.).

H. Start Time and Load Acceptance - Engines shall start, achieve rated voltage and frequency, and be capable of accepting load within ten seconds when properly equipped and maintained.

I. Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

J. The complete unit shall be equipped with a PMG (permanent magnet generator) to allow UPS systems and elevator systems to be connected to emergency system with no effect on emergency system performance.

2.2 ENGINE

A. The diesel engine shall be water-cooled 4-cycle compression ignition diesel turbo-charged for maximum efficiency. Engine speed shall not exceed 1800 RPM. No dual speed or multi-speed engines will be considered.

B. The engine shall be equipped with air filters, fuel filters and fuel pressure gauge, lubricating oil cooler, filters, and oil pressure gauge, water pump and temperature gauge, service hour meter, flywheel, and flywheel housing.

2.3 DUTY CYCLE

A. The engine shall be capable of operation at light loads for extended periods of time and shall provide for pre-combustion of fuel or a similar means for the prevention of carbonization.

2.4 GOVERNOR

A. The engine governor shall be an Electronic Speed Control. Speed droop shall be 0 (isochronous)

from no load to full rated load. Steady state frequency regulation shall be +\- 0.25%. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included.

2.5 COOLING SYSTEM - RADIATOR

A. The engine jacket water cooling system shall be a closed circuit design with provision for filling, expansion, and deration. The cooling pump shall be driven by the engine. Coolant temperature shall be internally regulated to disconnect cooling systems until operating temperature is achieved.

B. Heat rejected to the engine jacket water shall be discharged to the atmosphere through a close coupled engine mounted radiator. The radiator shall be sized to cool the engine continuously while operating at full rated load and at site conditions.

C. The fan, fan drive, and fan belts shall be covered with 14 gauge punched steel mesh guarding for personnel protection. The guarding shall conform to IEC 34-5, ISO and OSHA standards.

D. The radiator shall include a fuel cooler to return fuel per engine manufacturer's requirement.

2.6 HEATER AND ANTIFREEZE

A. The engines shall be provided with antifreeze (a solution of 50% ethylene glycol) and suitable unit mounted thermal circulation type water heaters incorporating a thermostatic switch to maintain engine jacket water to 90°F in an ambient temperature of 30°F. The heaters shall be sized as recommended by manufacturer, single phase, 60 hertz, voltage to match that shown on drawings. Heaters shall be Kim-Hotstart, Chromalox or accepted substitution.

2.7 LUBRICATION SYSTEM

A. The lubrication oil pump shall be a positive displacement type that is integral with the engine and gear driven from the engine gear train. The system shall incorporate full flow filtration with bypass valve to continue lubrication in the event of filter clogging.

B. The bypass valve must be integral with the engine filter base or receptacle. Systems where bypass valves are located in the replaceable oil filter are not acceptable.

2.8 FUEL SYSTEM

A. Provide electronically controlled fuel injection system for efficiency and emissions.

B. Fuel system shall be equipped with replaceable fuel filter elements which may be easily removed without breaking any fuel line connections or disturbing the fuel pumps or any other parts of the engine.

C. All fuel filters shall be conveniently located in one accessible housing, ahead of injection pumps so that fuel will have been thoroughly filtered before it reaches the pumps. No screens or filters requiring cleaning or replacement shall be used in injection pump or injection valve assemblies.

D. Engine shall be equipped with a fuel transfer pump, capable of lifting fuel against a head of twelve (12) feet, for supplying fuel through the filters to the injection pump at constant pressure.

E. In addition to the standard filter, the fuel system shall include a primary fuel filter between the fuel tank and transfer system to screen large contaminants.

F. A fuel/water separator shall protect the fuel system from water damage.

G. Provide and install complete electric solenoid fuel shut-off valve with connections, etc., with control switch. Locate switch near building shunt-trip switches, and label "Gen. Fuel Shut-Off".

2.9 STARTING

A. Starting Motor - A DC electric starting system with positive engagement drive shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Automatic Control - Fully automatic generator set start stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and two auxiliary contacts for activating accessory items. Controls shall include a 30 second single cranking cycle limit with lockout.

C. Batteries - A lead-acid storage battery to be used in conjunction with the electric starting system shall be provided. The battery shall be rated by the battery manufacturer in accordance with requirements set forth by the engine manufacturer. A fiberglass battery box with battery disconnects and necessary cables and clamps shall be provided. Batteries shall be mounted as shown. Wiring shall be sized as required by manufacturer for distance involved.

D. Battery Charger - Current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 1.4 volts per cell and equalize at 1.6 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC Voltmeter and fused AC input. AC input voltage shall be 120 volts, single phase. Amperage output shall be no less than 6 amperes. Charger shall be Lamarche A46 or equal. Charger shall have an auxiliary contact to close on charger failure.

2.10 OUTDOOR ENCLOSURE

A. The generator shall be enclosed in a level 2 (75db max) UL2200 listed aluminum enclosure.

B. The enclosure shall be wind rated to 160MPH per ASCE 7-05 exposure D, category 1 importance factor.

C. The exhaust silencer shall be fully enclosed.

D. Lockable doors shall provide for easy access to all major generator and engine components.

E. The generator within the enclosure shall be shipped as a pre-assembled and pre-integrated system. With integral louvers.

F. Rodent barriers shall be integrated into the enclosure.

G. Enclosure shall be mounted to a lifting base.

H. Provide stair/handrail assembly for maintenance access to enclosure doors to access control panels, load centers, etc.

I. Provide load center in enclosure for loads where indicated on plan drawings.

2.11 FUEL PIPING AND STORAGE TANKS

A. Tank: Above ground skid mounted fuel storage shall be provided under this section. All fuel oil

piping, remote fuel level gauges, lube oil sump tank lube oil piping, vent stack, and all necessary valves and fittings shall be provided and installed complete as required. The tank shall be a double wall above-ground base mounted with a minimum 72 hour capacity at 75% rated load. The Contractor shall be responsible for a complete fuel system installation. Storage tank shall be U.L. listed.

B. Fuel storage tank shall have a low level alarm set at 48 hours full load consumption with minimum tank size of 133 percent of the low level alarm.

C. Fuel storage tank shall include an internal leak detection monitor device in the inner cavity.

D. Coordination: It shall be the responsibility of the generator set supplier to coordinate all materials and all materials and work of other trades so that the total installation is complete and fully operational and meets all engine manufacturer's requirements. Any materials or installation required for proper interfacing of all trades shall be provided and installed by the generator set supplier.

E. Fuel Filter: Fuel system shall be equipped with replaceable fuel filter elements which may be easily removed without breaking any fuel line connection or disturbing the fuel pump or any other parts of the engine.

F. Fuel storage tank shall be an atmospheric tank with internal pressure less than 2.5 psi. Provide emergency vents as required by NFPA 30 to prevent pressure from exceeding 2.5 psi.

2.12 EXHAUST AND MUFFLER

A. A critical exhaust silencer shall be provided in accordance to the engine manufacturer's recommendations for silencing. The silencer shall provide extreme noise attenuation for environments with low background noise and slight noise emissions would be objectionable.

2.13 BASE AND ISOLATORS

A. The engine-generator shall be mounted on rubber pad type isolators. A concrete base shall be provided as specified by the manufacturer.

2.14 GENERATOR CONTROL PANEL (AND CONTROLS)

A. A generator mounted NEMA 1 type vibration isolated 14 gauge steel control panel shall be provided to meet requirements of NFPA 110 for Level 1 systems.

B. Equipment - Panel shall contain, but not be limited to the following equipment:

1. Voltmeter, +/- .5% accuracy (digital type)

2. Ammeter, +/- .5% accuracy (digital type)

3. Ammeter-Voltmeter phase selector switch

4. (Remote) Automatic starting controls as specified (with remote control)

5. Voltage level adjustment rheostat (+/- 5% voltage adjustment)

6. Frequency meter +/- .5%accuracy (digital type)

7. Dry contacts for remote alarms wire to terminal strips

8. Three position function switch marked "run" "off" "auto"

9. Equipment for shutdown required by NFPA 110:

    a. Overcrank

    b. High engine temperature

    c. Low lube oil pressure

    d. Overspeed

    e. Remote emergency stop

10. Equipment for Alarms required by NFPA 110:

    a. Control Panel Mounted Visual Indication:

        1) overcrank

        2) low water temperature less then 70°F (21°C)

        3) high engine temperature prealarm

        4) high engine temperature

        5) low lube oil pressure prealarm

        6) low lube oil pressure

        7) overspeed

        8) low fuel main tank

        9) EPS supplying load

        10) control switch not in “AUTO” position

        11) battery charger malfunctioning

        12) low voltage in battery

        13) lamp test

        14) contacts for local and remote common alarm

        15) low starting air pressure

        16) low starting hydraulic pressure

        17) air shutdown damper when used

b. Remote Audible:

1) overcrank

2) low water temperature less then 70°F (21°C)

3) high engine temperature prealarm

4) high engine temperature:

5) low lube oil pressure prealarm

6) low lube oil pressure

7) overspeed

8) low fuel main tank

9) control switch not in “AUTO” position

10) contacts for local and remote switch

11) air shutdown damper when used

11. Equipment for Controls required by NFPA 110

a. Manual Emergency shutdown. Mounted to exterior of building

C. Any additional safeties as recommended by the manufacturer or as required by applicable codes shall be provided. A mechanical overspeed system shall back up to the electric overspeed.

D. Provide all lock-out functions required by NFPA 110.

2.15 LOCAL MANUAL STOP STATION

A. Provide, install, and connect a local manual stop station of a type similar to a break-glass station located outside the room housing the prime mover (when so installed) or elsewhere on the premises when the prime mover is located outside the generator.

B. Locate at location acceptable to authority having jurisdiction.

2.16 SYSTEM SERVICE CONTRACT

A. The supplier of the standby power system must provide a copy of and make available to the Owner his standard service contract which, at the Owner's option may be accepted or refused. This contract will accompany any documents, drawings, catalog cuts, specifications sheet, wiring or outline drawings, etc. submitted for acceptance to the designing engineer.

2.17 ACCEPTABLE MANUFACTURERS

A. Basis of Design: Caterpillar or approved equal.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. The emergency generator shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes. Provide all associated control wiring to generator, transfer switches, etc. as required.

B. Provide all interface control wiring and conduit as required to provide complete emergency operation of equipment on project.

3.2 SITE TEST

A. An installation check and building load test shall be performed by the manufacturer's local representative. The ENGINEER, designer, regular operators and the maintenance staff shall be notified of the time and date of the site test. The tests shall include all tests specified by NFPA 11 Level 1. Additional tests shall be performed for automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load and automatic shutdown. Prior to this test, all timers shall be adjusted for proper system coordination.

3.3 LOAD BANK TEST

A. After the building load test, a load bank test will be performed. This test shall be done with resistive dry load banks, in the presence of the Engineer and Owner. Test shall be at a time mutually convenient with the Owner and in the presence of the ENGINEER.

1. 1 hour 50%

2. 1 hour 75%

3. 3 hours 100%

4. 10 minutes cool down

B. During test, a written log shall be maintained at 15-minute intervals with the following:

1. Ambient Air Temperature

2. Amperes

3. Hertz

4. Oil Pressure

5. Water Temperature

6. Battery Charging

3.4 EXHAUST STACK TEMPERATURE

A. Noise Level in dBA (each side)

B. Fuel for load test to be included in bid

## END OF SECTION 26 32 13.06

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# SECTION 26 33 53 - STATIC UNINTERRUPTIBLE POWER SUPPLY

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:

a. Surge suppression.

b. Input harmonics reduction.

c. Rectifier-charger.

d. Inverter.

e. Static bypass transfer switch.

f. Battery and battery disconnect device.

g. External maintenance bypass/isolation switch.

h. Remote UPS monitoring provisions.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. LCD: Liquid-crystal display.

C. LED: Light-emitting diode.

D. PC: Personal computer.

E. THD: Total harmonic distortion.

F. UPS: Uninterruptible power supply.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.

B. Shop Drawings: For UPS. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Manufacturer Certificates: For each product, from manufacturer.

C. Factory Test Reports: Comply with specified requirements.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. UL Compliance: Listed and labeled under UL 1778 by an NRTL.

**PART 2 - PRODUCTS**

2.1 OPERATIONAL REQUIREMENTS

A. Automatic operation includes the following:

1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.

2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.

3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.

4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.

5. If the battery becomes discharged and normal supply is available, the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.

6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.

7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.

8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.

9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.

2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions in subparagraphs below without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.

2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.

3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.

D. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.

1. Ambient Temperature for Electronic Components: 32 to 104 degrees F.

2. Relative Humidity: 0 to 95 percent, non-condensing.

3. Altitude: Sea level to 4,000 feet.

## 2.2 PERFORMANCE REQUIREMENTS

A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:

1. Inverter is switched to battery source.
2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
5. Load is 50 percent unbalanced continuously.

B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, **duration of supply is 10 minutes**.

C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 30percent from nominal voltage.

D. Overall UPS Efficiency: Equal to or greater than 98 percent at 100 percent load, 95 percent at 75 percent load, and 90 percent at 50 percent load.

E. Maximum Acoustical Noise: 60dB, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 48 inches from nearest surface of component enclosure.

F. Maximum Energizing Inrush Current: Six(6) times the full-load current.

G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.

H. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.

I. Limitation of harmonic distortion of input current to the UPS shall be as follows:

1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 10 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.

J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.

K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.

L. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current.

M. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

2.3 UPS SYSTEMS

A. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements.

Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.

B. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

C. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.

D. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch, and maintenance bypass/isolation switch. Protect rectifier-charger, inverter, controls, and output components.

1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.

E. Maintainability Features: Mount rectifier-charger and inverter sections and the static bypass transfer switch on modular plug-ins, readily accessible for maintenance.

F. Administration Building UPS, Capacity Upgrade Capability: Arrange wiring, controls, and modular component plug-in provisions to permit future100 percent increase in UPS capacity.

G. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of cabinet and discharge it near the top rear.

H. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.4 RECTIFIER-CHARGER

A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.

B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.

C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.

1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.

D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.5 INVERTER

A. Description: Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.6 STATIC BYPASS TRANSFER SWITCH

A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.

B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

2.7 BATTERY

A. Description: Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.

1. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

2.8 CONTROLS AND INDICATIONS

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.

C. Indications: Plain-language messages on a digital LCD or LED.

1. Quantitative indications shall include the following:

a. Input voltage, each phase, line to line.
b. Input current, each phase, line to line.
c. Bypass input voltage, each phase, line to line.
d. Bypass input frequency.
e. System output voltage, each phase, line to line.
f. System output current, each phase.
g. System output frequency.
h. DC bus voltage.
i. Battery current and direction (charge/discharge).
j. Elapsed time discharging battery.

2. Basic status condition indications shall include the following:

a. Normal operation.
b. Load-on bypass.
c. Load-on battery.
d. Inverter off.
e. Alarm condition.

3. Alarm indications shall include the following:

a. Bypass ac input overvoltage or undervoltage.
b. Bypass ac input overfrequency or underfrequency.
c. Bypass ac input and inverter out of synchronization.
d. Bypass ac input wrong-phase rotation.
e. Bypass ac input single-phase condition.
f. Bypass ac input filter fuse blown.
g. Internal frequency standard in use.
h. Battery system alarm.
i. Control power failure.
j. Fan failure.
k. UPS overload.
l. Battery-charging control faulty.
m. Input overvoltage or undervoltage.
n. Input transformer overtemperature.
o. Input circuit breaker tripped.
p. Input wrong-phase rotation.
q. Input single-phase condition.

r. Approaching end of battery operation.
s. Battery undervoltage shutdown.
t. Maximum battery voltage.
u. Inverter fuse blown.
v. Inverter overtemperature.
w. Inverter power supply fault.
x. Inverter transistors out of saturation.
y. Identification of faulty inverter section/leg.
z. Inverter output overvoltage or undervoltage.
aa. UPS overload shutdown.
bb. Inverter current sensor fault.
cc. Inverter output contactor open.
dd. Inverter current limit.

4. Controls shall include the following:

a. Inverter on-off.
b. UPS start.
c. Battery test.
d. Alarm silence/reset.
e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. UPS on battery.

2. UPS on-line.

3. UPS load-on bypass.

4. UPS in alarm condition.

5. UPS off (maintenance bypass closed).

E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.9 MAINTENANCE BYPASS/ISOLATION SWITCH

A. Description: Manually operated switch or arrangement of switching devices with mechanically actuated contact mechanism arranged to route the flow of power to the load around the rectifier-charger, inverter, and static bypass transfer switch.

1. Switch shall be mechanically.

2. Switch shall electrically isolate other UPS components to permit safe servicing.

B. Switch Rating: Continuous duty at rated full UPS load current.

C. Mounting Provisions: Separate wall- or floor-mounted unit.

2.10 MONITORING BY REMOTE STATUS AND ALARM PANEL

A. Description: Labeled LEDs on panel faceplate indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.

1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.11 SOURCE QUALITY CONTROL

A. Factory test complete UPS system before shipment. Use actual batteries that are part of final installation. Include the following:

1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.

2. Full-load test.

3. Transient-load response test.

4. Overload test.

5. Power failure test.

B. Observation of Test: Give fourteen (14) days' advance notice of tests and provide opportunity for Department's representative to observe tests at Department's choice.

C. Report test results. Include the following data:

1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.

2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.

3. List of instruments and equipment used in factory tests.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with installer present, for compliance with requirements for conditions affecting performance of the UPS.

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

3.2 INSTALLATION

A. Equipment Mounting: Install UPS on concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

3.3 GROUNDING

A. Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.4 IDENTIFICATION

A. Identify components and wiring according to Section 26 05 53 "Identification for Electrical Systems."

1. Identify each battery cell individually.

3.5 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Comply with manufacturer's written instructions.

2. Inspect interiors of enclosures, including the following:

a. Integrity of mechanical and electrical connections.

b. Component type and labeling verification.

c. Ratings of installed components.

3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.

4. Test manual and automatic operational features and system protective and alarm functions.

5. Test communication of status and alarms to remote monitoring equipment.

E. The UPS system will be considered defective if it does not pass tests and inspections.

F. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

G. Prepare test and inspection reports.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Department's maintenance personnel to adjust, operate, and maintain the UPS.

**END OF SECTION 26 33 53**

# SECTION 26 36 23 – BYPASS ISOLATION AUTOMATIC TRANSFER SWITCH

## PART 1 – GENERAL

### 1.1 SCOPE

A. Provide and install Automatic Transfer Switch(es) (ATS) with poles, ampere rating, voltage rating, and Withstand and Close Ratings (WCR) as shown on the contract drawings. Transfer Switches shall be with the isolation/bypass feature that has been prototype tested, factory built, production tested, and site tested. All Transfer switches and controllers shall be products of the same manufacturer.

B. The transfer switches shall have 600 Volt insulation on all parts in accordance with UL, IEC, and NEMA standards. The current rating shall be a continuous rating when the switch is installed in an enclosure, and shall conform to UL, IEC, and NEMA temperature rise standards.

### 1.2 CODES AND STANDARDS

The automatic transfer switch shall conform to the requirements of:

| | | |
|---|---|---|
| A. | UL 1008: | Underwriters Laboratories standard for automatic transfer switches |
| B. | CSA: | C22.2 No. 178 certified |
| C. | IEC: | 947-6-1 certified |
| D. | NFPA 70: | National Electrical Code including use in emergency and standby systems in accordance with Articles 517, 700, 701, 702 |
| E. | NFPA 99: | Essential electrical systems for health care facilities |
| F. | NFPA 101: | Life safety code |
| G. | NFPA 110: | Standard for emergency and standby power systems |
| H. | IEEE 241: | I.E.E.E. recommended practice for electrical power systems in commercial buildings |
| I. | IEEE 446: | I.E.E.E. recommended practice for emergency and standby power systems |
| J. | NEMA ICS10: | AC automatic transfer switch equipment |
| K. | UL 50/508: | Enclosures |
| L. | ICS 6: | Enclosures |
| M. | ANSI C33.76: | Enclosures |
| N. | NEMA 250: | Enclosures |
| O. | IEEE 472: | (ANSI C37.90A): Ringing wave immunity |
| P. | EN55022 (CISPR11): | Conducted and radiated emissions (Exceeds EN55011 & MILSTD 461 Class 3) |
| Q. | EN61000-4-2: | (Level 4): ESD immunity test Class B: |
| R. | EN61000-4-3: | (ENV50140): Radiated RF, electromagnetic field immunity |
| S. | EN61000-4-4: | Electrical fast transient/burst immunity test |
| T. | EN61000-4-5: | IEEE C62.41: Surge immunity test (1.2 x 50µs, 5 & 8 kV) |
| U. | EN61000-4-6: | (ENV50141): Conducted immunity test |
| V. | EN61000-4-11: | Voltage dips and interruption immunity |

### 1.3 APPROVED MANUFACTURERS

A. The automatic transfer switch with bypass/isolation basis of design is Cat® Model CBTS. Alternate manufactures shall submit a request and include a written list of deviations from this specification to be considered for approval.

1. Acceptable substitution.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. The manufacturer listed above is not relieved from meeting these specifications in their entirety. Equivalent products determined by the Engineer to be in full compliance with the specification may be acceptable.

C. All power and control equipment as specified in the contract documents shall be considered an integral part of the Standby Power System and shall be supplied by the Standby Power System Supplier. The Standby Power System Supplier shall be responsible for coordination of the entire Standby Power System to provide for unit responsibility.

## PART 2 – PRODUCTS

### 2.1 PERFORMANCE AND CONSTRUCTION

A. A transfer switch with bypass-isolation shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch that could not otherwise be tested, inspected and maintained without interrupting the load. Bypass of the load to either the normal or emergency power source with complete isolation of the automatic transfer switch shall be possible regardless of the status of the automatic transfer switch. The bypass-isolation switch shall permit simple operation by one person through the movement of a maximum of two handles. The entire system shall consist of two elements: the automatic transfer switch and the bypass-isolation switch furnished completely factory interconnected and tested.

B. The operating speed of the bypass-isolation contacts shall be independent of the speed of operation of the bypass handle.

C. The isolation handle shall provide three positions: Automatic, Test and Isolate. The Test position shall permit electrical testing of the automatic transfer switch without disturbing the load. The Isolate position shall completely isolate the transfer switch from both sources and load without actual removal of the line or load conductors and allow its removal for inspection and maintenance. The transfer switch shall be arranged for draw out operation to facilitate its removal. Also, while in the Test or Isolate positions, the bypass-isolation switch shall function as a manual transfer switch to allow load transfer to either source of power regardless of the position or condition of the transfer switch.

D. The load shall not be interrupted during bypass-isolation functions. The addition of load-break contacts that cause load interruption is not acceptable. The bypass-isolation switch contacts shall not be in the system current path except during actual bypass operation.

E. The complete bypass-isolation transfer switch shall be tested to ensure proper operation of the individual components, correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

F. The ATS with bypass-isolation shall be the product of one manufacturer and completely factory interconnected and tested so that only the services and load connections to the bypass-isolation switch are required for field installation. All interconnections between the transfer switch and the bypass-isolation switch shall be silver-plated bus bar.

G. The automatic transfer switch shall be of double throw construction operated by a reliable solenoid driven mechanism. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

H. The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

I. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

J. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Each ATS shall be in strict accordance and listed to UL 1008 withstand standards, including "Any Breaker" ratings. Minimum UL listed withstand and close into fault ratings shall be as follows:

| Size (Amps) | "Any Breaker" Rating | Current Limiting Fuse |
|---|---|---|
| 100 - 400 | 35,000 | 200,000 |
| 401 - 800 | 50,000 | 200,000 |
| 801 - 1200 | 50,000 | 200,000 |
| 1600 - 4000 | 100,000 | 200,000 |

(all values at 208V RMS symmetrical, less than 20% power factor)

ATS's which offer only 'specific coordinated breaker' ratings (as opposed to "any breaker" ratings) do not meet this specification and are not acceptable.

K. A dielectric test at the conclusion of the withstand and closing tests shall be performed.

L. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 208 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.

M. All relays shall be continuous duty industrial type with wiping contacts. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

N. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

O. An ATS manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.

P. Switches composed of molded case breakers, lighting contactors or components thereof will not be acceptable.

Q. The current rating shall be a continuous rating when the switch is installed in an enclosure and shall conform to NEMA temperature rise standards.

R. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.

S. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

T. Unless specified otherwise on the drawings, the switch shall be mounted in a NEMA 1 enclosure.

2.2 CONTROL

A. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:

1. Easy-to-view, backlit LCD display with long lasting LED indicators.
2. Control panel shall display voltage and frequency of both sources.
3. The user shall be able to view the last 16 recorded events.
4. Capability for optional external communication and network interface.
5. Adjustments to all settings shall be made from the front of the panel without opening the door.

B. The transfer switch controller shall be microprocessor based. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position, source availability, sequence indication and diagnostics.

C. All programmable and control functions shall be pass code protected and accessible through the keypad.

D. The control panel shall be provided with a simple user interface for transfer switch monitoring, control and field changeable functions and settings.

E. Touch pad test switch with Fast Test/Load/No Load selection capability to simulate a normal source failure.

F. The controller shall include a built in synchroscope to display the phase angle differential and ensure disturbance-free transfer operation between sources.

G. The controller shall provide digital timer adjustments with 1-second resolution. Voltage and Frequency shall be adjustable to 1% resolution to facilitate accurate transfer.

H. To ensure reliable and consistent user operation the controls must be equipped with nonvolatile memory and allow automatic daylight savings time adjustment.

I. A single controller capable of all transfer modes, open/delayed/closed and bypass isolation, shall be provided. Real time display of transfer status and active timers must be supplied.

J. The bypass-isolation transfer switch shall be furnished with a detailed step-by-step operating instruction plate as well as the following functional diagnostic lights:

- Normal source available
- Emergency source available
- Bypass switch in normal position
- Bypass switch in emergency position
- Automatic transfer switch in test position
- Automatic transfer switch isolated
- Automatic transfer switch inhibit
- Automatic transfer switch in normal position
- Automatic transfer switch in emergency position

## PART 3 – OPERATION

### 3.1 SEQUENCE OF OPERATION

A. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the normal source.

B. When the voltage of any phase of the normal source is reduced to 80% or exceeds 110% of nominal voltage, or frequency is displaced 2Hz from nominal, for a period of 0-10 seconds (programmable), a pilot contact shall close to initiate starting of the engine generator.

C. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the emergency source.

D. When the emergency source has reached a voltage value of +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

E. When the normal source has been restored to not less than 90% and not more than 105% of nominal voltage on all phases, the load shall be retransferred to the normal source after a time delay of 0 to 60 minutes (programmable; set at 30 minutes). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.

F. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.

### 3.2 ATS FEATURES

A. In addition to the operational elements required to satisfy the sequence of operation and other functions specified herein, the following ATS features shall be provided:

B. Adjustable time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds factory set at 3 seconds.

C. Adjustable time delay on retransfer to normal source, programmable 0-60 minutes factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls

shall automatically bypass the time delay and immediately retransfer to the normal position.

D. A time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.

E. An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.

F. An exerciser timer with momentary test pushbutton shall be incorporated within the microprocessor and shall be capable of starting the engine generator set and transferring the load (when selected) for exercise purposes on a daily, weekly or monthly basis. The exerciser shall contain a battery for memory retention during an outage.

G. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.

H. A set of customer contacts shall be provided to indicate both emergency and normal source position.

I. An adjustable over/under frequency and voltage sensor for both emergency and normal sources.

J. Visual indication of switch position and source acceptability shall be provided for both emergency and normal sources.

K. An engine start contact with an adjustable cool down timer. The bypass-isolation switch shall be equipped with an independent engine start circuit so that, should a utility outage occur while in the bypass-normal/ATS isolated condition, the engine will automatically start and allow immediate selection of emergency bypass.

L. A three phase Voltage Imbalance Monitor shall detect an imbalance and initiate a transfer to the alternate source. Adjustable 5-20% of nominal with a time delay of 10-30 seconds for nuisance conditions.

The following Exerciser Package shall be included:

A. Phase Rotation Sensing (R16) – Rotation shall be monitored on both sources.

The following additional accessories shall be included:

A. Communications interface card (ZNETM) – RS-485 Modbus

B. Digital Meter (M91) - Measures and displays true RMS volts, amps, power, energy, power factor, THD and frequency in a three-phase power system.

C. Additional Auxiliary Contacts (A3) - Closed when the transfer switch is in Source 2 position.

D. Additional Auxiliary Contacts (A4) - Closed when the transfer switch is in Source 1 position.

E. Alarm panel (CTAP) – Alarm on transfer to emergency w/silence button & light

F. Fan Contact (F) – Contact closes when engine runs.

G. Engine Mode Switch (SW1) – Three-position engine selector switch (auto/test/off).

H. Automatic or Manual Selector (S12) – Provide ability to manually transfer to Normal or Emergency sources.

## PART 4 – EXECUTION

### 4.1 GENERAL

The transfer switch shall be installed as shown on the plans, in accordance with the manufacture's recommendations and all applicable codes.

### 4.2 FACTORY TESTS

The transfer switch manufacturer shall perform a complete functional test on the switch, controller and accessories prior to shipping from the factory. A certified test report shall be available upon request.

### 4.3 SERVICE

The supplier of the ATS shall be the same as that of the engine generator set and shall maintain a national service organization that is factory trained and certified for transfer switch equipment. In addition, the genset dealer organization shall be available 24 hours per day, 365 days per year.

### 4.4 WARRANTY

The automatic transfer switch shall be warranted against defective workmanship for a period of two years, including both parts and labor.

## END OF SECTION 26 36 23

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# SECTION 26 36 23.06 – OUTDOOR AUTOMATIC TRANSFER SWITCH

## PART 1- GENERAL

1.1 SCOPE

A. Furnish and install the low voltage automatic transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings.

B. ATS to be provided for Life Safety and Optional Standby loads. Refer to one-line diagram and panel schedules.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specifications sections apply to this section.

1.3 RELATED SECTIONS

A. Section 26 24 16, Panelboards

B. Section 26 32 13.06, Outdoor Engine Generator, Sub-Base Tank

1.4 REFERENCES

A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:

1. UL 1008 – Transfer Switches
2. UL 991
3. NFPA 70 – National Electrical Code
4. NFPA 110 – Emergency and Standby Power Systems
5. NEMA ICS 10 – AC Transfer Switch Equipment
6. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems
7. IEC 801-2, 3, 4, and 5
8. CISPR 11
9. Compliant with FCC Part 15, Subpart B, Class A.

1.5 DESCRIPTION

A. Automatic transfer switch shall be capable of switching all classes of load, and shall be rated for continuous duty when installed in a non-ventilated enclosure.

B. Transfer switch shall be a true four (4) pole type. Normal and emergency full load current and voltage ratings at 60 cycles shall be as shown on plans.

1.6 SUBMITTALS

A. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

B. Submit shop drawings and product data clearly indicating:

1. All applicable options and accessories

a. Master drawing index

b. Front view and plan view of the assembly

c. Schematic diagram

d. Nameplate schedule

e. Component list

f. Conduit space locations within the assembly.

g. Assembly ratings including:

1) Short-circuit rating

2) Voltage

3) Continuous current rating.

2. Major component ratings including:

a. Voltage

b. Continuous current rating

c. Interrupting ratings

d. Cable terminal sizes and quantity

e. Product Data Sheets.

f. Delivery, storage and handling instructions.

3. Where applicable, the following additional information shall be submitted to the Engineer:

a. Busway connection

b. Connection details between close-coupled assemblies

c. Composite front view and plan view of close-coupled assemblies

d. Key interlock schematic drawing and sequence of operations

e. Mimic bus.

4. The following information shall be submitted for record purposes:

a. Final as-built drawings and information for items listed in section 1.4

b. Wiring diagrams

c. Certified production test reports

d. Installation information

5. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

6. Submittals and record drawings shall be submitted to the Project Manager.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.

1.7 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on drawings and as instructed by manufacturer.

1.8 OPERATION AND MAINTENANCE DATA

A. Operation Data:

1. Provide detailed instructions for operating equipment.

2. Include instructions for operating equipment under emergency conditions, including when engine generator is running.

B. Maintenance Data:

1. Provide routine preventative maintenance and lubrication schedule.

2. List special tools, maintenance materials, and replacement parts.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of ten years of experience.

B. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

C. Supplier: Authorized distributor of specified manufacturer with a minimum of three years of experience.

1.10 REFERENCES AND REGULATORY REQUIREMENTS

A. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

B. Provide a certificate of compliance with UL 1008 for the automatic transfer switches furnished under this section.

C. Conform to the requirements of the following:

1. NFPA 70 - National Electrical Code.

2. NEMA ICS 1 - General Standards for Industrial Control and Systems.

3. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

4. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.11 QUALITY ASSURANCE/TESTS

A. When conducting temperature rise tests to paragraph 99 of UL-1008 the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full rated current after completing the overload and endurance tests.

B. The switch shall meet or exceed the voltage surge withstand capability in accordance with IEEE Standard 472-1974 and the impulse withstand voltage test in accordance with NEMA Standard ICS 1-109.

1.12 DELIVERY, STORAGE AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.

B. Handle in accordance with manufacturer’s written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.13 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on drawings and as instructed by manufacturer.

1.14 MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.15 MAINTENANCE MATERIALS

A. Provide two of each special tool required for maintenance.

1.16 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each

major component. These manuals shall be incorporated into the O & M manuals submitted to the Engineer.

1.17 EXTRA PRODUCTS

A. Furnish and install all incidentals and appurtenances required for a complete and fully operational system to the satisfaction of the Engineer. Line and load terminals shall be capable of accepting the quantity and size of conductors as specified on the plans.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Asco Series 300.

1. Acceptable substitution.

B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. The manufacturer listed above is not relieved from meeting these specifications in their entirety. Equivalent products determined by the Engineer to be in full compliance with the specification may be acceptable.

C. All power and control equipment as specified in the contract documents shall be considered an integral part of the Standby Power System and shall be supplied by the Standby Power System Supplier. The Standby Power System Supplier shall be responsible for coordination of the entire Standby Power System to provide for unit responsibility.

2.2 GENERAL

A. The transfer switch shall be double throw, actuated by two electrical operators, momentarily energized and connected to the transfer mechanism by a simple overcenter linkage with time delay relays to control contact transition time on transfer to either source, adjustable 0-300 seconds. Time delay between the opening of the closed contacts and the closing of the open contacts shall be adjusted to allow for voltage decay before transfer as required to allow re-energization of motor and transformer loads at normal in rush currents. The transfer switch shall be capable of transferring successfully in either direction with 70% of the rated voltage applied to the switch terminals. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and emergency positions without the use of hooks, latches, magnet, or springs and shall be silver-tungsten alloy protected by arcing contacts, with magnetic blowouts on each pole. Parallel main contacts are not acceptable.

B. The transfer switch shall be equipped with a safe manual operator designed to be operated in the loaded condition and to prevent injury to operating personnel. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

C. Engine starting contacts shall be provided in transfer switch to start the generating plant if any phase of the normal source drops below 80% of rated voltage, after an adjustable time delay period of 0.5-3 seconds, to allow for momentary dips. The transfer switch shall not transfer to emergency until the generator source voltage and frequency have reached 90% of rated. After restoration of normal power on all phases to 90% of rated voltage, adjustable time delay period of 0-25 minutes shall delay transfer to normal power until it has had time to stabilize. If the emergency power source should fail during the time delay period, the time delay shall be by-

passed, and the switch shall return immediately to the normal source. Whenever the switch has retransferred to normal, the engine-generator shall be allowed to operate at no load for a fixed period of time (5 minutes) to allow it to cool before shut-down. The transfer switch shall include a test switch to simulate normal power failure with actual load transfer. Pilot lights shall be included on the cabinet door to indicate the main switch closed on normal or emergency, and two auxiliary contacts on the main shaft; one closed on normal, the other closed on emergency. In addition, two sets of relay contacts shall be provided to open and close upon loss of the normal power supply. All relays, timers, control wiring and accessories to be front accessible and be rated for the load and voltage as required for auxiliary control functions.

D. The transfer switch shall be UL listed for withstand and close-in values at least equal to the interrupting rating of the circuit breaker and/or fuse that is specified to protect the circuit, and available short circuit amps from the generator set.

E. The transfer switch shall automatically exercise the generating plant a no load or loaded condition. Exerciser shall be adjustable in 15 minute increments. Refer to Contract Documents for specific programming.

F. Transfer switch shall transfer normal supply to emergency within the time limits as required by the National Electrical Code for emergency loads (10 seconds for life safety).

G. When more than one emergency branch is shown, time delay relays shall be provided on the transfer to emergency operation for critical and equipment branch transfer switches. Time delay shall be adjustable 1-300 seconds and shall be adjusted in stages with the limits of the N.E.C. and as follows:

1. Life Safety Branch - no time delay on transfer to emergency.

2. Optional Standy Branch - shall transfer to emergency after the life safety branch has transferred to emergency and generator has recovered to 90% of rated voltage and frequency.

3. These time delays shall not effect or be a function of contact transition time as required in A above.

H. Transfer switch maximum dimensions shall be as shown on drawings.

## 2.3 CONSTRUCTION

A. The switching panel shall consist of completely enclosed contact assemblies and a separate control logic panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.

B. Each automatic transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads.

C. Automatic transfer switch shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles, and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.

D. The automatic transfer switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field.

E. Automatic transfer switches shall be applied as service entrance switches and provided with a service entrance label. An external key-operated selector switch shall be provided to disconnect the power supplies. Indicators shall be provided to show the availability of each source as well as breakers in a tripped or disconnected position. Provide a neutral-to-ground main bonding jumper for all switches to meet UL service entrance requirements.

2.4 MICROPROCESSOR LOGIC

A. The automatic transfer switches shall be controlled by an ASCO microprocessor-based controller or approved equivalent. The controller shall be hardened against potential problems from transients and surges. Operation of the automatic transfer switches and monitoring of both sources shall be managed by the controller.

B. Automatic transfer switches shall also have provisions for bell alarm and auxiliary switch wired out to terminals for Owner's use.

2.5 MICROPROCESSOR-BASED CONTROLLER

A. The microprocessor-based logic controller shall be door mounted and shall provide the operator with an overview of the automatic transfer switch status, parameters, and diagnostic data. The controller shall have a voltage range of 0-790 volts (50/60 Hz) and an accuracy of +/- 2% of nominal input voltage. The controller shall have a frequency range of 40-70 Hz and an accuracy of +/- .1 Hz. Control power input range shall be from 65V AC – 145V AC RMS 50/60 Hz. The controller shall be listed under UL Standard 1008.

B. The microprocessor-based controller shall include an LCD display, and shall display the following:

1. Line-to-line voltages for each source and the load

2. Line frequency for each source

3. Timer countdown for each timer while functioning

4. Real-time clock

5. Set points.

C. The microprocessor-based controller shall include mimic bus and individual LEDs for indicating the following:

1. Source available

2. Source connected

D. The microprocessor-based controller shall contain the following features:

1. Password programming protection.

2. Set points shall be stored in Non-Volatile memory, and use of an external battery source to maintain operation during "dead" periods shall not be required.

3. Program/run switch.

E. The microprocessor-based controller shall contain the following voltage and frequency features:

1. The voltage of each phase of the normal source and the alternate source shall be monitored, with undervoltage dropout adjustable from 50% to 90% of nominal and pickup adjustable from dropout setting +/-2% to 99% of nominal.

2. The voltage of each phase of the normal source and the alternate source shall be monitored, with overvoltage dropout adjustable from 105% to 120% of nominal and pickup adjustable from dropout setting +2% to 103% of nominal.

3. The frequency of the normal source and the alternate source shall be monitored, with underfrequency dropout adjustable from 90% to 100% of nominal and pickup adjustable from dropout setting +1 Hz to 99% of nominal.

4. The frequency of the normal source and the alternate source shall be monitored, with overfrequency dropout adjustable from 100% to 120% of nominal and pickup adjustable from dropout setting +1 Hz to 101% of nominal.

F. The microprocessor-based controller shall contain the following time delay features:

1. A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds.

2. A time delay shall be provided on transfer to alternate source, adjustable from 0 to 1800 seconds.

3. A time delay shall be provided on retransfer from alternate source to normal source, adjustable from 0 to 1800 seconds. This time delay shall be bypassed if emergency source fails and normal source is available.

4. A time delay shall be provided after retransfer that allows the generator to run unloaded prior to shutdown, adjustable from 0 to 1800 seconds.

5. A time delay shall be provided for the neutral position, adjustable from 0 to 120 seconds.

6. A time delay shall be provided for engine failure to start, adjustable from 0 to 6 seconds.

7. All delays shall be field adjustable from the microprocessor-based controller without the use of special tools.

G. The microprocessor-based controller shall contain the following features:

1. Pre-transfer signal, range 0-120 seconds

2. Plant exerciser, selectable – disabled or 7 day interval, 0-600 minutes load or no load

3. Retransfer mode – manual or automatic

4. Test pushbutton mode – disabled, load or no load.

H. The microprocessor-based controller shall contain the following input/output contacts:

1. Two (2) SPST contacts for generator start, rated 5A, 250V AC

2. Four (4) SPST contacts for control functions, rated 10A, 250V AC

3. Three (3) SPDT contacts for control functions, rated 10A, 250V AC

2.6 WIRING/TERMINATIONS

A. Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be arranged for entrance of external conductors from the top or bottom of the enclosure. The automatic transfer switch terminals shall be suitable for the termination of conductors shown on the plans.

2.7 POWER SWITCHING DEVICE

A. Protective switching devices shall be fixed mount molded case switch, Square D type LHL or accepted equivalent. Frame ratings shall be as noted. All switches shall be UL listed for application in their intended enclosures for 100% of their continuous ampere rating. Switches shall be electrically operated.

B. All switches shall be provided with a true, two-step stored energy mechanism providing a maximum of five-cycle closing. All the energy required for closing the switches shall be completely stored and held in readiness pending a release to close action. The molded case switches shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for molded case switches without maintenance.

2.8 RATINGS

A. The automatic transfer switches shall have equal withstand, closing and interrupting ratings as noted below, 3 cycle “any breaker rating.” The automatic transfer switches shall be service rated.

B. The automatic transfer switches shall be service rated for continuous duty.

C. The voltage rating of the automatic transfer switches shall be no less than the system voltage rating. The continuous current rating of the automatic transfer switches shall be no less than the maximum continuous current requirements of the system.

D. The automatic transfer switches shall be service rated for continuous duty as shown on the drawings and shall conform to the applicable requirements of UL 1008 for emergency system total load.

E. The automatic transfer switches shall be fully rated to operate all types of loads, inductive and resistive, from loss of continuity of power, without derating, either open or enclosed.

2.9 ENCLOSURE

A. Enclosure: ICS 6, Type 1.

B. Finish: Manufacturer’s standard gray enamel.

C. NEMA 4X stainless steel.

**PART 3 - EXECUTION**

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

B. Insulation check to ensure the integrity of insulation and continuity of the entire system.

C. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards

D. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances.

E. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic

F. The manufacturer shall provide six (6) certified copies of factory test reports.

3.2 FIELD QUALITY CONTROL

A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of five (5) working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

B. The contractor shall provide six (6) copies of the manufacturer's field start-up report.

3.3 MANUFACTURER'S CERTIFICATION

A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

B. The Contractor shall provide six (6) copies of the manufacturer's representative's certification.

3.4 EXAMINATION

A. Verify that surface is suitable for transfer switch installation.

B. Provide housekeeping pads for all floor mounted switches.

3.5 INSTALLATION

A. The transfer switch shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.

B. Provide and install automatic transfer switches with the number of poles and accessories noted on the drawings. Maintain required NEC safe working clearances.

C. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

D. The equipment shall be installed and checked in accordance with the manufacturer's recommendations.

E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

F. Provide all associated control wiring to generator as required.

G. Provide and install all interface control wiring and conduit as required to provide required emergency operation of equipment on project as applicable.

3.6 SITE TEST

A. An installation check and building load test shall be performed by the manufacturer's local representative. The Engineer, designer, regular operators and the maintenance staff shall be notified of the time and date of the site test. The tests shall include automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted and all necessary programming completed for proper system coordination.

3.7 DEMONSTRATION

A. Demonstrate operation of transfer switch in normal and emergency modes.

3.8 TRAINING

A. The contractor shall provide a training session for up to five (5) owner’s representatives for two (2) normal workdays at a jobsite location determined by the owner.

B. The training session shall be conducted by a manufacturer’s qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly with "hands on" type training with a previously owner approved outline for the specific equipment.

3.9 FIELD SERVICE ORGANIZATION

A. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

3.10 SITE TEST

A. An installation check and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators and the maintenance staff shall be notified of the time and date of the site test. The tests shall include automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load and automatic shutdown. Prior to this test, all automatic transfer switch timers shall be adjusted for proper system coordination.

B. Test all equipment.

**END OF SECTION 26 36 23.06**

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# SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

## PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of a complete lightning protection system.

1.3 DESCRIPTION

A. A Lightning Protection System shall be provided and installed on the structure even though not shown on drawings, by experienced LPI Certified Installers in compliance with provisions of Code for Lightning Protection Systems as adopted by the National Fire Protection Association and Underwriters' Laboratories. All equipment to that result shall be included whether or not specifically called for herein with the additional requirement that the system shall meet all the requirements of LPI.

B. Materials shall comply in weight, size and composition with the requirements of Underwriters' Laboratories and the National Fire Protection Code relating to this type of installation, and shall be UL Labeled.

C. All materials, where available by any one manufacturer, shall be cast.

D. System shall comply with the following:

1. LPI

2. ANSI/NFPA 780; Class I (Class II for buildings over 75 feet in height)

3. UL 96A; Master Label for:

a. New installation

1.4 REFERENCES

A. ANSI/NFPA 780 - Lightning Protection Code.

B. ANSI/UL 96 - Lightning Protection Components.

C. LPI - Lightning Protection Institute.

D. UL 96A - Installation Requirements for Lightning Protection Systems.

1.5 SUBMITTALS

A. Submit shop drawings showing layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details. Drawings shall include full layout of cabling and points, and connections.

B. Submit product data showing dimensions and materials of each component, and include indication of listing in accordance with ANSI/UL 96.

C. Submit manufacturer's installation instructions.

D. Submittal shall include ground rods and ground wells as called for in Section 26 05 26 – Grounding and Bonding.

1.6 PROJECT AS-BUILT DOCUMENTS

A. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors on red lined as-built documents.

1.7 QUALIFICATIONS

A. Manufacturer: Company specialized in lightning protection equipment with minimum five (5) years documented experience and member of the Lightning Protection Institute.

B. Installer: Authorized installer of manufacturer with minimum five (5) years documented experience and member of the Lightning Protection Institute.

1.8 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference one (1) week prior to commencing lightning protection work.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with roofing and exterior and interior finish installations.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Thompson Lightning Protection, Inc.: Premium Line.

B. Independent Protection Company, Inc.: Premium Line.

C. Heary Bros. Lightning Protection: Premium Lines.

2.2 MATERIALS

A. Components: In accordance with ANSI/UL 96 and LPI.

B. Air Terminals:

1. Air Terminals shall be solid (aluminum) as required to match roof conductors, and shall have proper base support for surface on which they are attached, and shall be securely anchored to this surface.
2. Terminal length: Comply with NFPA 780.
3. Air Terminal for Chimneys: Lead-coated copper.

C. Conductors:

1. Roof conductors shall consist of aluminum complying with the weight and construction requirements of the Code. Roof conductor material shall match and be compatible with roof flashing material.

2. Down conductors shall be copper, and shall be provided where shown installed in PVC conduit and hidden within the structure.

D. Fastener: Conductor fasteners shall be of the same material as the conductor, having ample strength to support conductor.

E. Connectors and Splicers: Bronze or aluminum as required to be compatible with conductor being connected.

F. Ground Rods: Comply with all requirements of Sections 26 05 26.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify that field measurements are as shown on shop drawings.

C. Beginning of installation means installer accepts existing conditions.

3.2 PROTECTION OF SURROUNDING ELEMENTS

A. Protect elements surrounding work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with UL 96A, ANSI/NFPA 780, and LPI.

C. Install ground rods in accordance with Section 26 05 26. Where conflict exists between the requirements of Section 26 05 26 and this Section, the most stringent shall govern.

D. Installation shall be made in an inconspicuous manner with conductors routed to conceal as much as possible. Down conductors shall be concealed within structure, and shall be run in 1" PVC conduit. See Paragraph 'F' below and NFPA 780 4.15.1.

E. Where fasteners are to be mounted in masonry or structural work, they shall be furnished to the Masonry or Structural Contractor so they may be installed during construction of the project.

F. Conductors concealed in steel reinforced concrete shall be installed and bonded per NFPA 780 4.15.3. Specific attention is brought to the requirements of 4.9.13 requiring down conductors to be connected to reinforced steel at its upper and lower ends.

G. Lightning protection system shall be bonded to metal bodies as required by NFPA 780 4.21.

H. Provide proper connections of lightning protection system to all grounded media in and around the protected structure per NFPA 780 4.20 "Potential Equalization".

I. Provide proper grounding of all grounding media in, on and around structure to provide common ground potential per NFPA 780 4.14 including electric service, telephone and antenna system grounds as well as underground metallic piping systems, underground metal conduits, etc.

J. Ground Ring: Bond to ground ring system. See Section 26 05 26. Items required to be bonded/connected in 'H' and 'I" above shall be bonded/connected via ground ring system where available and applicable.

K. All exposed conductors located 6 ft. or less above finished floor or finished grade are to be suitably protected/shielded as well as other exposed locations where conductor is subject to mechanical damage.

L. Coordinate and receive approval of all penetrations of roofing system and mounting to roofing system with Designer and Roofing Contractor prior to submittal of shop drawings.

M. Coordinate and receive approval of all connections to structural steel, rebar, and other structural elements with Structural Engineer prior to submittal of shop drawings.

N. Ground Terminals:

1. Ground connections shall be made in accordance with requirements of all applicable codes and Section 26 05 26 (including but not limited to requirements for testing, ground rods, materials, wells, etc.).
2. Ground rods shall be placed outside, a minimum of two (2) feet from building foundations. Top of rod shall be at least one (1) foot deep into earth (i.e., with minimum earth cover of one (1) foot).
3. Each and every ground rod location shall consist of:
    a. Two or more 20 ft. ground rods (5/8" copper) at no less than 20 ft. spacing shall be driven vertically to a depth resulting in one (1) foot earth cover.
    b. Bond the two or more ground rods together with a cable size that meets the applicable requirements of NFPA 780 for Class I or II locations as applicable.
    c. Provide additional rod electrodes as required to achieve specified ground resistance.
    d. Complete installation shall exceed the minimum requirements of NFPA 780.
    e. Provide grounding well enclosure at each ground rod location in accordance with Section 260526.

## 3.4 FIELD QUALITY CONTROL

A. Test grounds per Section 26 05 26.

B. Obtain UL Master Label and attach to building at location directed by OAR. Submit copy of paperwork to OAR and submit in O & M Manual.

C. Submit test results on each ground location including final length of each ground rod and final distance between each installed ground rod at each ground rod location.

D. Test results per section 00 65 00.

**END OF SECTION 26 41 13**

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# SECTION 26 43 13 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contractual Conditions and Division 26 Specification sections apply to this section.

1.2 SUMMARY

A. This section includes the requirements for provision and installation of surge suppression equipment for 120 volt AC to 480 volt AC circuits.

1.3 DESCRIPTION

A. Provide all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building electrical and electronics systems from the effects of line induced transient voltage surge and lightning discharge as specified for systems with voltages between 120VAC and 480VAC.

B. Provide surge suppression equipment for the following equipment:

1. Each new main electrical service switchboard.

2. Distribution and branch panels as called for on drawings.

3. Point of use locations (receptacles, plug-in units) as required.

C. All surge protection to be connected via a 3-pole circuit breaker (whether shown on Plans/Schedules or not.)

1.4 SUBMITTALS

A. Submit the following Product Data for each type of suppressor:

1. Dimensions

2. Means of mounting

3. Compliance with UL Standards referenced

4. Compliance with IEEE Standards referenced

5. Design type (Hybrid, MOV)

6. Internal fusing/Thermal Protection

7. Recommended overcurrent protection

8. Size of wire leads

9. Visual failure indicator

10. Warrantee

11. Performance data showing compliance with performance as specified herein

12. Non-Potted construction

1.5 PROJECT AS-BUILT DOCUMENTS

A. Record locations of surge protection units; indicate actual units used on red lined as-built documents.

1.6 OPERATION AND MAINTENANCE DATA

A. All approved shop drawings, product data, and cutsheets.

B. Installation, connection, and maintenance information on each type of surge suppression.

C. Procedure and time table for recommended periodic inspection of devices to determine usefulness and life expectancy.

1.7 QUALITY ASSURANCE

A. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment.

B. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor. Factory representatives are to approve installation prior to Substantial Completion.

1.8 REFERENCES AND REGULATORY REQUIREMENTS

A. Equipment Certification: Surge suppression equipment shall be UL listed and labeled for intended use.

B. Surge suppression devices shall be selected, installed and located in accordance with requirements of the following:

1. ANSI/NFPA 780 - Lightning Protection Code, latest edition.

2. ANSI/NFPA 70 - National Electrical Code, current adopted year.

3. U.L. 1449 – 3rd Edition, Standard for Safety for Surge Protective Devices.

4. 1363-1986 - Standard for Temporary Power Taps.

5. ANSI/IEEE C62.41-1991 (IEEE 587) - Guide for Surge Voltages in Low-Voltage AC Power Circuits.

6. ANSI/IEEE C62.33-1982 - Standard Test Specifications for Varistor Surge Protection Devices.

7. ANSI/IEEE C62.45-1987 - IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

1.9 COORDINATION/PROJECT CONDITIONS

A. Verify proper grounding is in place.

B. Verify if space and proper clearance for the surge suppressor installation is available.

C. Coordinate so that proper overcurrent device, as recommended by manufacturer, is installed to feed each surge suppression device.

1.10 WARRANTY

A. All surge suppression devices shall be warranted to be free from defects in materials and workmanship for a period of five (5) years.

B. Any suppressor which shows evidence of failure or incorrect operation during the warranty period shall be repaired or replaced at no cost to the owner.

**PART 2 - PRODUCTS**

2.1 GENERAL

A. Suppressors shall be designed for the specific type and voltage of electrical service and shall provide clamping action for both normal (L-N) and common (L-N-G) mode protection.

B. Suppressors shall be of a hybrid design, and include circuitry with tight, wave-tracking clamping characteristics.

C. Suppressors shall be designed to withstand a maximum continuous operating voltage of not less than 115% of nominal RMS line voltage.

D. Suppressors shall contain internal safety fusing to disconnect the suppressor from the electrical source if the suppressor fails, in order to prevent catastrophic failure modes.

E. Suppressors shall be fail safe, shall allow no follow-thru current, shall have repeated surge capability, shall be solid state, shall be self-restoring, and shall be fully automatic.

F. Suppressors shall be UL 1449 listed and shall be approved for the location in which they are installed.

2.2 SUPPRESSOR CRITERIA

A. Main Electrical Service Entrance Suppressors (First Level of Protection) shall meet or exceed the following:

1. General:

a. Suppressors shall be tested as per IEEE C62.41-1991 to determine clamping voltage using Cat. C3 test criteria.

b. Suppressors shall be sequential surge tested as per IEEE C62.45-1987, and shall withstand 1000 test cycles at 10kA, Cat. C3 test criteria.

c. Internal fusing for each phase connected.

d. Fail-safe with no hold over current.

e. Enclosure:

1) listed.

2) Fire retardant.

3) NEMA 1 as required for each location.

2. 400kA.

a. Maximum Surge Capacity: 400,000 Amps. per phase.

b. Clamping voltage:

1) Category B, UL 1449, Line to Neutral impulse (6KV - 1.2 x 50 µs, 3kA - 8 x 20 µs):

a) 120/208V, 3Ø, 4W: 600V

b) 277/480V, 3Ø, 4W: 920V

2) Category C3, Line to Neutral impulse (20KV - 1.2 x 50 µs, 10kA - 8 x 20 µs):

a) 120/208V, 3Ø, 4W: 1160

b) 277/480V, 3Ø, 4W: 1660

c. The unit suppressor shall be designed with redundant back-up surge protection in the event of a module failure.

1) Module status indicators shall be provided to indicate individual module status. When a module has failed, the module LED status indicator shall indicate said failure.

2) Unit status indicators shall be provided to indicate the status of the complete unit suppressor. The LED status indicators shall be located on the hinged front cover to redundantly indicate module or unit failure.

d. Basis of Design:

1) Advanced Protection Technologies, Inc. #XTE/*XLHP/CL/DC Series for applied voltage in enclosure or integral to switchgear as noted on Drawings.

2) Equal by Eaton, integral to equipment.

3) Equal by Square D.

4) Equal by PQ Protection.

B. Branch Distribution and/or SubPanels (Second Level of Protection), suppressors shall meet or exceed the following:

1. General.

a. Suppressors shall be tested as per IEEE C62.41-1991 to determine clamping voltage using Cat. B3 test criteria.

b. Suppressors shall be sequential surge tested as per IEEE C62.45-1987, and shall withstand 1000 test cycles at 3kA, Cat. B3 test criteria.

c. Internal fusing for each phase connected.

d. Fail-safe with no hold over current.

e. Enclosure:

1) listed.

2) Fire retardant.

3) NEMA 1.

2. 160kA.

a. Replaceable module design.

b. Maximum Surge Capacity: 160,000 Amps. per phase.

c. Clamping voltage:

1) Category B, UL 1449, Line to Neutral impulse (6KV - 1.2 x 50µs, 3kA - 8 x 20µs):

a) 120/208V, 3Ø, 4W: 530

b) 277/480V, 3Ø, 4W: 920

d. The panel mounted unit suppressor shall be designed with redundant back-up surge

e. *protection in the event of a module failure.

1) Module status indicators shall be provided to indicate individual module status. When a module has failed, the module LED status indicator shall indicate said failure.

2) Unit status indicators shall be provided to indicate the status of the complete unit suppressor. The LED status indicators shall be located on the hinged front cover to redundantly indicate module or unit failure.

f. Basis of Design:

1) Advanced Protection Technologies #TE/*XT/160/DC Series for applied voltage in enclosure as required on drawings, as specified above, and/or as required by applicable codes.

2) Equal by Eaton, integral to equipment.

3) Equal by Square D.

4) Equal by PQ Protection.

3. 25kA Unit (Third Level of Protection)

a. Maximum Surge Capacity: 25,000 Amps.

b. Clamping Voltage at UL 1449, Line to Neutral Category B Impulse, (6kV – 1.2 x 50µs, 3kA, 8 x 20µs):

1) 120/208V, 3Ø, 4W: 500

2) 277/408V, 3Ø, 4W: 900

C. Point of Use Location (120 Volt), Hardwire.

1. 1449 Listed.

2. 20 Amp, 120V rated. All components must be 20 Amp rated.

3. Suppressors shall be tested per IEEE, C62.41-1991 for categories A and B.

4. Internal fusing.

5. Indicators for normal operation and failure indication.

6. Enclosure: Fire retardant high impact, phenolic or plastic housing or metal enclosure.

7. Clamping voltage UL 1449, Line to Neutral, Category B impulse at (3kA, 8 x 20 µs): 350V @ 120V.

8. Maximum Surge Capacity: 20,000 Amps.

9. Maximum continuous operating voltage: 115% of line voltage.

10. Provide hardwire connection or add 20 amp receptacle device to hardwired devices to match equipment being protected and maintain UL Listing.

D. Point of Use Location (120 Volt) Plug Strip

1. 20 amp, 120V rated.

2. Suppressors shall be tested per IEEE, C62.41-1991 for categories A and B.

3. Normal Mode (L - N), and common mode (L+N-G) protection.

4. Internal fusing.

5. 6 ft. line cord.

6. Protected outlets.

7. Indicators for normal operation and failure indication.

8. Re-settable circuit breaker.

9. On/off switch.

10. Extruded aluminum enclosure.

11. Clamping voltage UL 1449, line to neutral, Category B impulse at (3kA, 8 x 20 µs): 310V @ 120V.

12. Maximum Surge Capacity: 20,000 Amps.

13. Maximum continuous operating voltage: 135V.

## PART 3- EXECUTION

### 3.1 GENERAL

A. Provide suppressor at first piece of electrical equipment (switchboard) that the electrical service encounters as it enters the facility.

B. Provide suppressor at each branch panel as noted on drawings.

C. Provide surge suppression at location where data, metering, or monitoring equipment is connected to line voltage (120V). Provide cords and receptacles as required to connect TVSS equipment to equipment being protected and maintain UL listing.

### 3.2 INSTALLATION OF SUPPRESSORS

A. Suppressors shall be installed as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.

B. Suppressors shall be close nippled to the device being protected in a position near the neutral bus which will minimize lead length between suppressor and the buses or control breaker to which the suppressor connects. Suppressor leads shall not extend beyond the suppressor manufacturer's recommended maximum lead length without specific approval of the Designer.

C. Location shown on drawings is diagrammatic only.

D. Suppressors shall be installed in a neat, workmanlike manner. Lead dress shall be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.

E. Supplementary grounding and bonding connections required between the bonding bus or ground plane for each equipment cluster and other locations as indicated herein shall be accomplished using #6 AWG core copper conductor and approved connections unless otherwise noted. Referenced to a common earth ground.

F. Suppressors shall be installed in a manner that allows simple replacement within short periods of downtime.

G. Suppressors other then point of use type shall be installed with a means of disconnecting the suppressor at the panel. At the main service entrance location, provide a dedicated 30 amp, 3P-CB, 100,000 A.I.C. for the TVSS device. At the distribution secondary and subpanel locations, provide dedicated 20 amp or 30 amp, 3P-CB's, for the TVSS device. Label disconnect or CB "Surge Protector". Change rating of CB's noted above as required to properly provide system as recommended by manufacturer.

H. Suppressors at main switchgear are to be mounted integral to switchgear. Comply with all codes and UL labeling. Provide UL label for complete system. All status indicators are to be mounted to switchgear door, visible from exterior of switchgear without requiring operation of door, lid, etc.

## END OF SECTION 26 43 13

# SECTION 26 51 00 LED LIGHTING

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. LED luminaire.

2. Luminaire supports.

B. Related Requirements:

1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multi-pole lighting relays and contactors.

2. Light Emitting Diode (LED) lighting is used exclusively. Any other lighting source (fluorescent, compact fluorescent, incandescent, HID, etc.) shall not be reviewed as an equivalent lighting fixture.

1.2 DEFINITIONS

A. CAD: Computer-aided design.

B. CCT: Correlated color temperature.

C. CRI: Color Rendering Index.

D. Fixture: See "Luminaire."

E. IP: International Protection or Ingress Protection Rating

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data sheet for each fixture indicating which features, accessories, and finishes are being provided.

3. Include physical description and dimensions of each luminaire.

4. Ballast data sheet for each fixture, including BF.

5. LED Fixtures: Include the fixture assembly “Full Load Amps” at “Defined Voltage,” and fixture to be labeled with this information.

6. Lamp data sheet for each fixture, including life, output (lumens, CCT, and CRI), and

energy efficiency data.

7. Substitute Fixtures: Include photometric data, both electronic copies of IES files and hard copies, with adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the luminaire as applied in this project.

1.4 INFORMATIONAL SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Lamp/Driver
4. Energy-efficiency data.
5. Life, output, and energy-efficiency data for lamps.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

C. Qualification Data: For agencies providing photometric data for lighting fixtures.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in maintenance manuals.

1. Provide a list of all lamp types used on project; use ANSI and manufacturers' codes.

2. Provide a list of all LED assemblies/lamps with replacement used on project.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED FIXTURE: 10 percent spare LED assemblies for each fixture type selected based on the total fixtures used for each building with minimum of one (1) items per fixture type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. LED fixtures - Warranty Period: Five (5) years from date of Final Acceptance.

2. LED Drivers - Warranty Period: One (5) year from date of Final Acceptance.

3. Emergency Lighting Batteries - Warranty Period: Five (10) years) from date of Final Acceptance.

**PART 2 - PRODUCTS**

2.1 LED LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Recessed Fixtures: Comply with NEMA LE 4.

D. Bulb shape complying with ANSI C79.1.

E. CRI of minimum 80. CCT of 3000 K.

F. Rated life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: As indicated on contract drawings.

2.2 EMERGENCY LED POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with fixture. Comply with UL 924.

1. Emergency Connection: Operate continuously at an output of minimum 700 lumens, unless noted otherwise. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.

2. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

3. Battery: Sealed, maintenance-free, nickel-cadmium type.

4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED. Self-test shall be every thirty (30) days.

## 2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.

c. CCT and CRI for all luminaires.

## 2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish shall match luminaire.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

E. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

F. Flush-Mounted Luminaire Support:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

H. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

2. Do not attach luminaires directly to gypsum board.

I. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and Section 26 05 33 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

## END OF SECTION 26 51 00

# ITEM L-150 – INSTALLATION OF SERIES PLUG CUTOUTS (SCO)

## PART 1 - DESCRIPTION

1. 01

A. This item shall consist of furnishing and installing the series plug cutout in accordance with these specifications.

B. This item shall also include all wire and cable connections, the furnishing and installing of all necessary conduits and fittings and all necessary mounting structures. It shall also include the testing of the installation and all incidentals necessary to place the cutouts in operation as completed units to the satisfaction of the Engineer.

## PART 2 - EQUIPMENT AND MATERIALS

2. 01 SERIES PLUG CUTOUT

A. The series plug cutout shall conform to the requirements described in FAA Advisory Circular 150/5340-30 (Current Edition).

2. 02 EQUIPMENT SUPPLIED

A. The series plug cutout shall be supplied for the total quantity as shown on the plans. Each lot shipment of cutouts shall include two Instruction Manuals.

2. 03 SERIES PLUG CUTOUT

A. The series plug cutout shall be used to isolate the series circuit from the constant current regulator during maintenance or testing operations. It shall also allow periodic insulation resistance measurement of the series circuit (with respect to earth ground) without disconnecting the series cable.

B. The series plug cutout shall have a nominal working voltage of 5KVAC and a nominal carrying current capacity of 6.6A. The insulating parts shall be made from flame retardant epoxy resin. Porcelain is not acceptable.

C. The series plug cutout shall have three working positions- “operation”, “maintenance” and “test and measurement”. The “normal” and “maintenance” positions shall be lockable with a key for enhanced safety. Insulation resistance measurement between the series circuit and ground shall be possible without disconnecting any cable. An incorporated micro-switch shall provide the capability to disable the CCR remote control wire (in order to prevent the CCR from being switched on in Remote) when the cover is removed. The built-in micro-switch shall be designed to energize the CCR (in Remote) after the contacts are engaged (or de-energize the regulator before the SCO high voltage contacts are totally opened).

D. The cutout shall be designed and constructed to resist rough handling and to present durable insulation properties even in high indoor ambient humidity conditions. The cutout shall have dependable insulation under all conditions due to the use of flame retardant epoxy resin. It shall use a special epoxy resin that is more shock-resistant than porcelain. The SCO shall have an integral handle with a positive grip that will assist extraction and insertion efforts. The cutout shall be compatible with all types of L-828/L-829 CCRs and L-847 circuit selectors. The cutout shall

have heavy brass terminals for easy and reliable connection of series cables.

## PART 3 - CONSTRUCTION METHODS

3. 01 PLACING THE SERIES PLUG CUTOUT

A. The contractor shall furnish and install each series plug cutout as specified in the proposal and shown in the plans.

3. 02 TESTS

A. Each series plug cutout shall be checked to verify that the input and output side is properly wired. All series plug cutouts shall be fully tested in the "operation" position by continuous operation for not less than 24 hours as a completed system prior to acceptance. The test shall include operating the constant current regulator in each step not less than 10 times at the beginning and end of the 24-hour test. The series circuit fixtures shall illuminate properly during each portion of the test. The "maintenance" and "test and measurement" position shall be checked for proper operation at the end of the 24 hour test.

## END OF ITEM L-150

# ITEM L-829 – INSTALLATION OF FERRORESONANT L-829 CCR

## PART 1 - GENERAL

1. 01 DESCRIPTION

A. This item shall consist of furnishing and installing the L-829 constant current regulator (CCR) in accordance with FAA 150/5345-10F and these specifications. All applicable specifications of FAA 150/5345-10F shall apply.

B. This item shall also include ACE-3 distributed control and monitoring units (DCMU) for new CCRs and retrofit existing CCRs with ACE-3 kits for control and monitoring including all circuit breakers, wire and cable connections, the furnishing and installing of all necessary conduits and fittings and all necessary mounting structures in conjunction with ALCMS. External ACE-3 Combo Box shall be provided for existing CCRs where internal retrofit kits could not be installed for relocated CCRs. It shall also include the testing of the installation and all incidentals necessary to place the CCRs in operation as completed units to the satisfaction of the Engineer.

## PART 2 - PRODUCTS

2. 01 EQUIPMENT AND MATERIALS

1. L-829: The L-829 CCRs shall be ETL certified according to the requirements of FAA Advisory Circular 150/5345-10F "Specification for Constant Current Regulators and Regulator Monitors." The L-829 shall be Ferroresonant and shall be 6.6A, 3 or 5-step as required, 7.5KW, 10KW, 30KW; with an input voltage of 208Vac. The remote-control voltage shall be 120Vac and capable of connecting external UPS power source 120Vac.

2. Existing type L-828 CCRs that could not be retrofitted with internal ACE-3 units with IRMS capability, shall be provided with external ACE-3 Combo Box for controlling and monitoring.

3. Existing type L-828 and L-829 CCRs shall be upgraded to L-829 CCRs with ACE-3 unit including IRMS and the monitoring where indicated on plans.

2. 02 EQUIPMENT SUPPLIED

A. A quantity of one each L-829 CCRs shall be supplied. Each CCR shall include two Instruction Manuals.

B. The CCR shall supply three or five precision output levels to power the airfield lighting circuit. Output current levels shall be maintained within ±3% at any intensity step. Nominal output current levels shall be maintained even when 30% of the isolation transformers have open secondaries. If input power loss occurs, operation shall resume within five seconds after restoration of input power.

C. The CCR shall use a Ferroresonant design that produces minimal EMI, high efficiency and near unity power factor for AC 150/5345-10 test conditions. The CCR shall exceed the EMI testing requirements specified in FAA AC 150/5345-10 (current edition).

D. An insulation resistance monitoring system shall be provided. The IRMS shall be capable of monitoring and reporting the insulation resistance of the series circuit. The contractor shall be responsible to make all arrangements for IRMS installation.

E. Directly stack two equal CCRs using a manufacturer supplied stacking kit. In addition, it shall be possible to stack different combinations of CCRs assuming the larger CCR is on the bottom.

F. The CCR shall have output current surge limitation and soft-start to provide maximum airfield lamp protection. The CCR shall include overcurrent and open-circuit protection. No tools shall be needed to open a hinged front access door. To improve safety, no high voltage shall be present inside the front door area. Lightning protection on both the input and output of the CCR shall be provided.

G. Monitor:

1. The monitor must detect the status of the CCR and the series lighting circuit.

2. Existing CCRs shall be upgraded to L-829 CCRs by adding internal ACE-3 or external ACE-3 Combo units including IRMS and the monitoring where indicated on plans.

3. The monitor must be matched with the CCR so it will function when the CCR is powering a load with a nominal value that is between 50 and 100 percent of its rated capacity. The load must be a constant current loop that energizes the primary of isolating transformers that are specified in AC 150/5345-47, *Isolation Transformers for Airport Lighting Systems.* The secondary winding of the transformers will power airport lighting fixtures.

4. At a minimum, the monitor must operate on the top two steps of Style 1 (3 brightness steps) and Style 2 (5 brightness steps) regulators.

5. The monitor must detect the following fault conditions:

| CCR FAULT CONDITIONS | |
|---|---|
| **Fault Letter** | **Fault Condition** |
| a | Loss of ac input power to the CCR |
| b | Shutdown of the regulator due to operation of protective circuits described in paragraph 3.3.10 |
| c | A 10 percent or greater drop in the volt-amperes (VA) delivered to the series circuit. |
| d | Failure of the regulator to deliver the output current that corresponds to the brightness step selected (see Table 1). |
| e | Failure of a preset number of lamps in the series circuit. |

6. See above Table Faults a, b, and d must be detected at all brightness levels.

7. The monitor must function when the regulator is in the remote or local control modes (fault "d" must be detected in the remote mode but need not be detected in the local mode).

8. The monitor must operate in a fail-safe manner and not cause the regulator to be inoperable or output incorrect currents.

9. If it is required by the application, the output of the monitor must energize the coil of a single pole double throw (SPDT) relay when the regulator is operating properly.

   a. The relay contacts must be rated for a 2 amp resistive load at 120 Volts ac, 60 Hz.

   b. The monitor outputs must be connected to a terminal block to allow external connections and operate with control lines.

10. Upon the initial detection of a fault, the monitor must delay 5.0 seconds (except for fault "a" and "b" in Table 3) before the fault is displayed. If the fault still exists after 5 seconds, the monitor must indicate an alarm.

11. A visual indication must be provided on the monitor to indicate which monitored parameter caused the fault indication (except for fault "a").

12. A regulator "on" light must be provided on the monitor.

13. The load of each monitored airfield lighting system lamp and its associated isolation transformer may vary between 10 and 200 watts within the following:

    a. All fixture loads and transformers must be the same.

    b. There cannot be devices on the series circuit which will cause the load to vary greatly (signs with fluorescent ballasts/lamps, power adapters, signs with printed circuit board assemblies, etc.).

    c. Film disc cutouts must not be used since they will cause a load different than an open circuit series to series transformer.

14. The monitor must be adjustable so the number of failed lamps required to cause a failure indication may be from 4 to 10 when the series loop is loaded with identical wattage lamps. For mixed wattage bulbs on the same series loop, a loss of 10% or more CCR load must be detected.

15. After the preset number of monitored lamps fail, it must be possible to switch the monitor into a degraded operation mode.

16. When in the degraded operation mode, the monitor must deactivate the fault indication and reactivate it upon the failure of an additional preset number of lamps (1 to 5).

17. Additional monitor warnings or alarm levels may be optionally provided by the manufacturer but are not required.

## PART 3 - EXECUTION

### 3. 01 CONSTRUCTION METHODS

A. Placing The L-829 CCR: The contractor shall furnish and install each L-829 CCR as specified in the proposal and shown in the plans. Existing relocated CCRs shall be upgraded with adding new ACE-3 units with IRMS capability. Existing type L-828 CCRs that could not be retrofitted with internal ACE-3 units with IRMS capability, shall be provided with external ACE-3 Combo Box for controlling and monitoring. The CCRs shall be mounted in the vault at the location shown on the plans and coordinated with the Owner for final placement.

B. Tests: The CCR shall be calibrated according to the manufacturer's instructions using a True RMS meter. An open-circuit test, conducted according to the manufacturer's instructions, shall also be performed. The CCR shall then be fully tested by continuous operation for not less than 24 hours prior to acceptance. The test shall include operating the constant current regulator in each step (Local and Remote) not less than 10 times at the beginning and end of the 24-hour test.

C. Existing regulators shall remain operational until the new and relocated regulators have been installed and verified for correct operation. The changeover period shall be kept to a minimum so that the tower does not lose control for longer than is necessary.

## END OF SECTION L-829

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# ITEM L-890 – AIRFIELD LIGHTING CONTROL & MONITORING SYSTEM (ALCMS) RELOCATION

## PART 1 - GENERAL

1. 01 SUBMITTALS

A. General: Comply with the general requirements of the Contract governing submittals and supplemental requirements specified in Specification Section 26. Provide submittals for each different product specified herein.

B. Provide shop drawings of ALCMS system and wireless communication system including wiring diagrams, ladder diagrams and system block diagrams. The Contractor shall coordinate with ALCMS system provider for all the components required for a complete ALCMS relocation and providing new components.

1. 02 REFERENCE DOCUMENTS

A. FAA Advisory Circulars

1. AC 120-28 Criteria for Approval of Category III Weather Minima for Takeoff, Landing, and Rollout

2. AC 120-29 Criteria for Approval of Category I and Category II Weather Minima for Approach

3. AC 120-57 Surface Movement Guidance and Control System

4. AC 150-5340-30 Design and Installation Details for Airport Visual Aids

5. AC 150/5345-3 Specification for L-821 Panels for Control of Airport Lighting

6. AC 150/5345-5 Circuit Selector Switch

7. AC 150/5345-10 Specification for Constant Current Regulators and Regulator Monitors

8. AC 150/5345-28 Precision Approach Path Indicator (PAPI) Systems

9. AC 150/5345-53 Airport Lighting Equipment Certification Program

10. AC 150/5370-10 Standards for Specifying Construction of Airports

B. FAA ORDERS

1. Order 6750.24 Instrument Landing System and Ancillary Electronic Component Configuration and Performance Requirements

2. Order 6850.2A Visual Guidance Lighting Systems

3. Order 7110.65 Air Traffic Control

C. MILITARY STANDARDS

1. MIL-STD-810F DoD Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

1. 03 QUALIFICATIONS

A. The ALCMS manufacturer shall be listed in the FAA Approved Equipment List, AC 150/5345-53 (current edition), and a FAA approved supplier of L-890 ALCMS in accordance with AC 150/5345-56.

B. The ALCMS manufacturer shall have demonstrated a minimum of five (5) years of experience in airfield lighting control and monitoring systems.

1. 04 PROJECT SCOPE

A. Relocate existing ALCMS to new airfield lighting vault from old vault. Upgrade existing computer systems and laptop with new computer system including hardware and software. Replace old touchscreens with new touch screens. Provide any or all components to furnish and commission a complete and functional control and monitoring system based on an industry standard. The primary function of the ALCMS is to provide remote and monitoring capability of the equipment in the electrical vaults. The primary location for the user interface to the system is at the cab of the Airport Traffic Control Tower (ATCT). Secondary optional monitoring points for the system are from the ATCT mechanical room, new vault and the remote laptop.

B. This project shall include software, programming, on-site commissioning, on-site testing, on-site training and any other materials, tools and equipment to provide a fully functional system to the satisfaction of the owner.

C. Work directly with Airport Traffic Control Tower personnel to replace existing touch screens.

D. This work shall also include the connecting to the existing/new airfield lighting control and monitoring system (ALCMS), the marking and labeling of equipment and the labeling or tagging of wires; the testing of the installation; and the furnishing of all incidentals necessary to place it in operating condition as a completed unit to the satisfaction of the Engineer.

E. This Work shall include wireless internet network connection in place of existing BelAir radio. Provide internet connection devices for new roaming laptop and computer in the new vault which requires modem and sim cards including data plan from mobile service carrier (Verizon, T-mobile, AT&T, etc). Coordinate with the Owner for internet service carrier approval.

F. New two-way radios for exiting Beacon monitoring and control.

G. New Antenna for existing L-854 radio.

1. 05 PROJECT COORDINATION

A. The ALCMS manufacturer shall provide an experienced and qualified Engineering, Sales and Service staff to support contractor and airport throughout the installation and life of the system.

B. Provide sequence of relocation process for review of Airport, Engineer, and FAA.

1. 06 CONTRACTOR INSTALLATION REQUIREMENTS

A. The installing contractor shall be responsible for the physical installation of all associated ALCMS components. At a minimum, this includes the Constant Current Regulators (CCRs), ALCMS

cabinet, Touchscreen control station, new computers, new laptop, wireless cellular service, and other control equipment.

B. The Contractor shall furnish, install, relocate, connect and test all equipment, equipment accessories, conduit cables, wires, buses, grounds and support necessary to insure a complete and operable electrical distribution facilities for the airport lighting system as specified herein the submittal package.

C. The equipment installation and mounting shall comply with the requirements of the National Electrical Code and local code agency having jurisdiction.

D. Wire and Connections

1. The Contractor shall make all necessary electrical connections at each location in accordance with the ALCMS manufacturer's wiring diagrams.

2. All wires called out in the drawings associated with equipment that is to be controlled or monitored should be pulled, terminated and dressed at the appropriate terminal blocks and at the associated equipment.

3. In wiring to the terminal blocks, the Contractor shall leave sufficient extra length on each control lead to make future changes in connections at the terminal block.

E. Marking and Labeling

1. All equipment, control wires, terminal blocks, etc., shall be tagged, marked or labeled as specified below:

2. Wire Identification: The Contractor shall furnish and install self-sticking wire labels or identifying tags on all control wires at the point where they connect to the control equipment or to the terminal blocks.

3. Wire labels, if used, shall be of the self-sticking, pre-printed type and of the manufacturer's recommended size for the wire involved. Identification markings designated in the plans shall be followed.

4. Tags, if used, shall be nonferrous metal or plastic. Each tag shall be securely tied to the proper wire by a nonmetallic cord or plastic wire tie.

F. Installation of Data Cables

1. The Contractor shall install, terminate and test all data cables required for the project. This includes all of the following components: Data cable, Terminal cabinets, Jumper cables

2. All associated data cables shall be tested upon completion of the cable installation and termination of connectors.

3. Tests shall include verification of point-point continuity of each wire.

4. All test data shall be recorded and composed into a test report and shall be submitted to the airport / owner for approval.

5. Commissioning of the system shall not begin until all test reports are submitted and approved, and a copy provided to ALCMS Manufacturer.

G. Contractor Fiber Optic Communication Equipment Installation

1. The Contractor shall install, terminate and test all fiber optic communications required for the project. This includes all the following components:

a. Fiber optic cable

b. Fiber optic patch panels

c. Fiber optic jumper cables

d. Fiber connectors / couplings

e. Fiber junction Boxes

2. Installation of the fiber optic communication equipment shall be done by a trained and qualified fiber optic specialist.

3. The qualifications of the company and specialist to install the fiber optic equipment shall be submitted to the airport / owner for approval.

4. All associated fiber optic equipment including fiber cables, splices, jumper cable shall be tested upon completion of the fiber cable installation and termination of connectors.

5. Tests shall include verification that the 'dB loss versus the distance of the fiber pull' is within acceptable limits.

6. All test data shall be recorded and composed into a test report and shall be submitted to the airport / owner for approval.

7. Commissioning of the system shall not begin until all test reports have been submitted and approved.

H. Contractor Wireless Communication Equipment Installation

1. Provide internet connection devices for new roaming laptop and computer in the new vault which requires modem and sim cards including data plan from mobile service carrier (Verizon, T-Mobile, AT&T, etc.). Analyze and evaluate available 3G/4G signal strength of cellular service providers (Verizon, T-Mobile, AT&T, sprint, etc.) in vicinity of new vault. Coordinate with the Owner for the selection of cellular service provider. Prepare the documentation and any incidental for cellular service contract for the Owner. Provide sim card for new laptop and modem for computer SiteManger and LinkManager software or approved equal compatible with the ALCMS system using 3G/4G cellular service. Provide cellular signal booster antenna (if required).

2. New two-way radio shall be provided for existing Beacon located in the airfield side. Provide new din rail mounted 2.4ghz I/O radios and Yagi antennas with surge protection for existing beacon control and monitoring in each beacon cabinet in new vault and at the beacon tower. Select the frequency range with no interference for radio signals in the vicinity. Existing 24V power source at the beacon tower and existing beacon cabinets shall be re-utilized including existing contactors and associated components. Add current sensor and necessary components for monitoring of beacon ON/OFF status at the beacon tower and confirmation thru radio signal. Contractor shall provide all required hardware for a complete beacon control and monitoring system using radio control.

3. New antenna for L-854 radio shall be provided. The lightning protection for antennas shall be provided by the ALCMS manufacturer.

4. The antenna masts shall be furnished by the ALCMS manufacturer and installed by the electrical contractor.

5. The supply, installation and termination of the interconnecting cable (between the antennas and wireless communication equipment) and associated equipment including connectors and couplings shall be the responsibility of the electrical contractor.

6. The Contractor shall install and terminate all wireless communication equipment required for the project. This includes all the following components:

a. Antenna(s)

b. Antenna mast(s)

c. RF cable

d. RF connectors

e. Antenna Lightning arrestors

f. Ground connections

g. Wireless Communication Module (Mounted in Tower near Antenna)

h. Ethernet cable (Run between wireless communication module and Tower computer)

7. Installation of the wireless communication equipment shall be done by a trained and qualified RF specialist.

8. The qualifications of the company and specialist to install the wireless communication equipment shall be submitted to the airport / owner for approval.

9. All associated RF equipment including antennas and RF cables shall be tested upon completion of the cable installation and termination of connectors.

10. The tests shall include an impedance check of the RF cable and a VSWR (Virtual Standing Wave Ratio) test.

11. All test data shall be recorded and composed into a test report and shall be submitted to the airport / owner for approval.

12. Commissioning of the system shall not begin until all test reports have been submitted and approved by the ALCMS manufacturer.

I. Contractor Hard-wire Data Cable Installation

1. The Contractor shall install, terminate and test all hard-wire communications required for the project. This includes all of the following components:

a. ALCMS manufacturer specified data cable

b. Data cable termination panels

c. Data cable jumper cables

d. Connectors / couplings

e. Junction Boxes

2. Installation of the data cable shall be done by a trained and qualified specialist.

3. All associated cabling, splices, jumper cable shall be tested upon completion of the cable installation and termination of connectors.

4. Tests shall include verification that the ‘dB loss versus the distance of the cable pull’ is within acceptable limits.

5. All test data shall be recorded and composed into a test report and shall be submitted to the airport / owner for approval.

6. Commissioning of the system shall not begin until all test reports have been submitted and approved.

## 1. 07 CONTRACTOR POWER-UP AND INITIAL TESTING

A. The Contractor shall perform the following power-up and commissioning tasks:

1. Connect all communication equipment between Tower and Vault ALCMS assemblies.

2. Power up Vault and Tower ALCMS assemblies.

3. Verify communication is established between Tower and Vault ALCMS assemblies.

4. Initiate lighting commands from Tower Touchscreen and verify proper control operations are being executed at the Vault ALCMS.

5. Test monitoring feedback to verify proper wiring and operation.

6. Inform ALCMS manufacturer in writing all mentioned power up tests are complete.

1. 08 ALCMS MANUFACTURER ALCMS COMMISSIONING

A. The ALCMS Manufacturer shall perform the following commissioning tasks:

1. Verify Contractor connections including power, control and monitoring.

2. Verify proper labeling of equipment.

3. Verify communication connections.

4. Perform training on ALCMS control system.

5. System Readiness Check

6. Assist Contractor with performing the System Acceptance Testing (SAT).

1. 09 SYSTEM ACCEPTANCE TEST (SAT)

A. Following the final installation and commissioning of the system, the ALCMS Manufacturer shall perform a demonstration of the system performance. This demonstration shall include the following:

1. Lighting control functions

2. Monitoring functions

3. Alarm functions

B. The ALCMS Manufacturer shall develop a SAT test plan in accordance with the specifications.

C. The SAT shall be witnessed by owner representatives, the contractor or the engineer.

1. 10 MANUALS

A. The ALCMS Manufacturer shall provide four (4) hard copies of the operation and maintenance manuals that are hard-covered and suitable for daily operation and maintenance of the system. The manuals shall include the following information:

1. Operational overview and system description

2. Graphical User Interface Screen operation

3. System Block Diagram

4. Detailed external wiring diagrams (Electrical Contractor wiring)

5. Detailed input/output terminal diagrams

6. Detailed assembly drawings and wiring diagrams

7. Original Equipment Manufacturer (OEM) Manuals

B. The manuals shall be spiral bound or supplied in 3-ring binders. The cover of each binder shall be labeled with all project-related information.

1. 11 AS-INSTALLED DRAWINGS

A. The ALCMS Manufacturer shall provide four (4) hard copies of As-Installed drawings after system acceptance. The As-Installed drawings shall include the following information:

1. System Block Diagram (1-line drawings)
2. System External Wiring Diagrams
3. Assembly Drawings
4. Assembly Wiring Diagrams

B. The As-Installed drawings shall be 11" X 17" in size and shall be spiral bound or supplied in 3-ring binders. The cover of each binder shall be labeled with all project-related information.

1. 12 ON-SITE TRAINING

A. The ALCMS Manufacturer shall provide training during the commissioning trip.

B. Any audio/video recordings of training classes described herein are the sole responsibility of the contractor. Coordination of the video recording must be organized by the Contractor and approved by the engineer.

C. All training sessions shall be held in a facility provided by the airport. This facility should have tables, chairs, projection screen and sufficient space to lay out manuals and drawings.

D. The ALCMS Manufacturer shall provide all required visual aids and projectors.

E. Air Traffic Controller Training

1. The ALCMS Manufacturer shall provide two (2), 1 hour User Training Class for Air Traffic Control Tower (ATCT) personnel.
2. ATCT Training coordinator should be present for both classes and shall be the responsible for training remaining personnel not able to attend these classes.
3. This training shall include discussion and review of the following:
   a. ALCMS General System Overview
   b. Touchscreen Operations
   c. Command and Control Sequences
   d. Alarm and Warning Messages
   e. Failsafe Conditions
   f. Granting Local Control to the Vaults
4. Training classes for ATCT personnel should be limited to a maximum of 4-6 people per class.
5. Air Traffic Control should designate a training coordinator that shall be responsible for scheduling and organizing on-site training for their personnel. In addition, this coordinator shall be responsible for training other personnel that were absent or unable to attend the training sessions.
6. Any additional training beyond contract requirements shall be the responsibility of the ATCT training coordinator to complete.

F. Maintenance Training

1. The ALCMS Manufacturer shall provide one (1), 8 hour (one day) training class for maintenance personnel. This training shall include discussion and review of the following:
   a. System Block Diagram

b. System Assemblies and Wiring Diagrams

c. Touchscreen Operation

d. Maintenance and Troubleshooting

e. Granting Local Control to the Vaults

f. Power Up and Power Down Sequences

g. Failsafe Operations

h. Implementing Airfield Lighting Changes

i. Maintenance Report Generation

2. Training classes for maintenance personnel should be limited to a maximum of 4-6 people per class.

3. Maintenance should designate a training coordinator that shall be responsible for scheduling and organizing on-site training for their personnel. In addition, this coordinator shall be responsible for training other personnel that were absent or unable to attend the training sessions.

4. Any additional training beyond contract requirements shall be the responsibility of the training coordinator to complete.

1. 13 OWNER SYSTEM ACCEPTANCE AND WARRANTY START DATE

A. Upon successful completion of the SAT and on-site training the owner shall issue the ALCMS Manufacturer a written notice of system acceptance within five (5) working days.

B. The date the final acceptance letter is received or five (5) days following successful completion of the SAT (whichever occurs first) represents the start of the warranty period. Please refer to the Warranty section for more information regarding the ALCMS warranty guarantee.

1. 14 SYSTEM WARRANTY

A. All equipment shall be warranted against defects in workmanship, hardware and software for a period of twenty-four (24) months from the date of final system acceptance.

B. During this time period the ALCMS manufacturer shall provide all parts, labor and technical support with the following conditions:

1. The manufacturer shall correct by repair or replacement, at its option, equipment or parts which fail because of mechanical, electrical or physical defects, provided that the goods have been properly handled and stored prior to installation, properly installed and properly operated after installation, provided further that Buyer gives manufacturer written notice of such defects after delivery of the goods to Buyer.

2. The manufacturer may examine any goods upon which a claim is made in the same condition as when defect therein is discovered and may require the return of the goods to establish any claim.

3. The manufacturer's liability under no circumstances shall exceed the contract price of goods claimed to be defective.

4. Any returns under this guarantee are to be on a transportation charges prepaid basis. For products not manufactured by, but sold by the manufacturer, warranty is limited to that extended by the original manufacturer.

1. 15 SYSTEM SERVICE AND SUPPORT

A. The ALCMS Manufacturer shall provide technical assistance and support during the warranty

period.

B. The ALCMS Manufacturer shall provide 7 days a week / 24 hours a day support phone line.

C. The ALCMS Manufacturer shall provide technical phone support within four (4) hours of the initial call.

D. The ALCMS Manufacturer shall provide free phone consultation and technical support as required during the warranty period and if necessary shall be on-site within 24 hours.

E. At the request of the airport/owner, the ALCMS Manufacturer shall provide information about preventative maintenance programs and extended warranty packages.

## PART 2 - EQUIPMENT AND MATERIALS

### 2. 01 GENERAL

A. The ALCMS system shall be based on industrial standard ALCMS components.

B. Fiber optic communication network shall be used for data transfer between the electrical vault and control tower.

C. All touchscreen panel computers shall use flash hard drive technology and store all airport specific custom programs on Compact Flash (CF) for easy service replacement.

D. The ALCMS system shall be comprised of the following major hardware components:

1. One new touchscreen control station located in the tower cab.
2. One new monitor and two computers in tower base.
3. One new monitor, new enclosure, and two computers in new Vault.
4. New antenna for the relocated L-854 radio control.
5. New Laptop and operating system upgrade to latest version for new laptop and new computers.

### 2. 02 COMMUNICATION NETWORK

A. The tower and electrical vault(s) shall communicate with following communication networks.

1. Fiber Optic, Multi Mode:

a. Supply, installation, termination and testing of the fiber optic cable and associated equipment including fiber cable, fiber patch panels, fiber patch cables, connectors and couplings shall be the responsibility of the electrical contractor.

b. The fiber optic cables shall be multi mode, 62.5/125 micron fiber cable, TC rated. Each fiber communication link requires 2 fibers.

c. All fiber optic cable shall be terminated at a fiber optic patch panel within each subsystem before being terminated at the communication equipment.

d. Fiber optic jumper cables shall be provided from the fiber patch panel to the computer equipment enclosures.

e. Fiber optic cable shall be terminated with connectors at the fiber optic transceivers located within the vault computer cabinet.

f. Fiber optic runs shall not exceed 10km. For longer distances, please contact the ALCMS manufacturer.

g. Fiber optic runs shall be direct point-point runs with no splices when possible.

h. Fifty percent (50%) spare fiber cables shall be pulled and terminated within the fiber optic patch panel for future expansion.

i. Upon completion of fiber optic installation, the contractor shall provide airport/owner with a test report which shall include dB loss test results.

2. Wireless (for new Laptop)

a. The antenna and respective components for laptop wireless connectivity shall be relocated from old vault to new vault.

b. The antenna mast shall be provided and installed by the electrical contractor.

c. The supply, installation and termination of the interconnecting cable (between the antenna and wireless communication equipment) and associated equipment including connectors and couplings shall be the responsibility of the electrical contractor.

d. Existing repeater shall be realigned for maximum reception for the radio signal.

## 2. 03 VAULT EQUIPMENT

A. Vault ALCMS Assembly

1. The Vault ALCMS equipment

a. Provide new computers, laptop, mouse, keyboard, and monitor at the new vault in new enclosure. The Vault ALCMS Assembly houses the Vault communication equipment as well as computers with redundancy for control and monitoring requirements specified at the Vault.

b. The relocated ALCMS Assembly is to be installed by the Contractor in coordination with the airport/engineer.

c. The Vault ALCMS shall continuously check for proper operation of all the communication links connected to the ALCMS and report any alarms to the tower.

d. In the event of total communication loss or system failure, the Vault ALCMS shall go to failsafe.

2. Uninterruptible Power System

a. An uninterruptible power system (UPS) shall be provided for supporting power of the equipment.

b. The UPS shall be capable of supplying full load power for 10 minutes after loss of main input power.

c. The UPS shall be a stand-alone unit installed next to the vault equipment enclosure.

3. Industrial Enclosures

a. A NEMA 12 industrial enclosure is provided for housing associated Vault ALCMS equipment.

b. The enclosure is designed for indoor use to provide protection against dust, dirt, dripping water, and external condensation of non-corrosive liquids.

c. The environmental conditions within the area of the enclosure installation will

not exceed 122°F (50°C) or fall below 32°F (0°C).

d. Installation of the vault equipment is the responsibility of the electrical contractor. The electrical contractor with the airport and/or owner will coordinate the installation and locations of the vault equipment.

2. 04 TOWER EQUIPMENT

A. Tower Equipment

1. Tower Equipment Room – Computers and Monitor

a. Provide new computers, mouse, keyboard, and monitor at the new vault in existing enclosure. Tower ALCMS Assembly houses the communication equipment as well as computers with redundancy for control and monitoring requirements.

b. Installation is to be completed by the Contractor in coordination with ATCT Technical Services.

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2. Tower Cab - Touchscreen Panel PC

a. Existing Tower Touchscreen Panel shall be replaced with new Touchscreen Panel installed in the Air Traffic Control Tower cab.

b. Installation is to be completed by the Contractor in coordination with ATCT Technical Services.

c. The Contractor is responsible for any additional shelves, connections, etc. to provide a clean and professional installation under the Tower cab console.

2. 05 COMPUTERS, LAPTOP, AND TOUCHSCREEN PANELS

A. Computers

1. All computers for the ALCMS system shall be industrial-grade and have the following technical specifications:

| | **Options** | **Description** |
|---|---|---|
| a. | Type | Embedded Computer |
| b. | Processor Type | Intel E3845 – 1.91GHz minimum |
| c. | Memory Capacity | 8GB DDR3 RAM minimum |
| d. | Features | 4 X RS232/422/485<br>1 X USB 3.0<br>3 X USB 2.0<br>2 X LAN 2-Gigabit<br>4 X DI, 4 X DO |
| e. | Hard Disk | 128GByte Solid State Flash Drive |
| f | Operating System | Windows 10™ |
| g. | Monitor | LCD |
| h. | Size | 19 |
| i. | Resolution | 1280 X 1024 minimum |

Table 5: Computers, Laptop and Monitors Specifications

B. Laptop

1. 14” semi-rugged laptop with HD (768p) and FHD (1080p) displays.
2. Proposed laptop shall have a wireless device to connect to ALCMS. Provide all the programing and hardware for a complete monitoring and controlling system functionalities including wireless connection.

C. Touchscreen Panel

1. The touchscreen shall be 19” LCD Open-Frame with aspect ratio 5X4 and resolution 1280X1024.
2. Proposed Touchscreen shall be fit in the same allotted space where existing touchscreen is being replaced.

D. Flash Drive

1. The computer shall use a solid state Flash Drive (no moving parts) and it shall be a Memtech or approved equal.
2. The Flash Drive shall be a minimum of 128G Bytes
3. The Flash Drive shall operate at temperatures from -40 degrees C to +85 degrees C
4. The Flash Drive shall have 1000G operating shock and 15G operating vibration rating.
5. The drive shall have a 10 year rated data integrity specification.
6. The Flash Drive shall use Active Remap versus Wear Leveling to assure extended drive life.
7. The Flash Drive shall store the operating system and any programs that require erase/read/write cycles.
8. Flash Drive specification sheets shall be provided with Submittal showing proposed flash drive meets specification requirements.

E. Flash Drive Service / Repair

1. The touchscreen computer shall be able to be rebuilt using a new blank Flash Drive or blank standard Hard Drive.
2. The computer shall be able to boot from the CF Card and execute a “Ghost” image rebuild program.
3. The rebuild program shall extract and copy the “Ghost” image, all configurations and airport specific programs from the CF Card to the new blank Flash Drive.
4. Upon completion of the rebuild program, the touchscreen computer shall be able to be rebooted and be completely operational.

## PART 3 - MAN-MACHINE INTERFACE OPERATION

3. 01 TOUCHSCREEN CONTROL METHODOLOGY

A. Existing touch screen methodology shall remain.

3. 02 TOUCHSCREEN GRAPHICS

A. Existing touchscreen display a graphical pictorial representation of the airport runways, taxiways and other requested airport features and shall remain.

B. Graphic screen requirements including types, quantities, functions, etc shall be coordinated with ATCT staff, Owner, and Engineer if any change is required.

3. 03 VAULT EMERGENCY GENERATOR CONTROL

A. The ALCMS shall provide control of the emergency diesel generator(s) located in the airfield lighting vault(s) from all of the control stations.

B. The ALCMS shall provide one (1) dry-contact output point(s) at the Vault.

C. The ALCMS shall close the output to command the generator ON and open the output to turn the generator OFF.

D. Locating and wiring of the output points within the Generator equipment shall be completed by the Contractor in coordination with the airport/engineer and equipment manufacturer (if required).

3. 04 VAULT AUTOMATIC TRANSFER SWITCH (ATS) AND GENERATOR MONITORING

A. The ALCMS system shall provide the optically isolated digital inputs to monitor the following feedback points:

1. Utility Available
2. Utility On-line
3. Generator Available
4. Generator On-line
5. Generator Alarm

B. Locating and wiring of the monitoring points within the ATS and generator equipment shall be completed by the contractor in coordination with the airport/engineer and equipment manufacturer.

3. 05 NAVIGATIONAL AID CONTROL

A. The ALCMS shall provide control of the existing control items at the new vault from the control station.

B. The ALCMS shall close the output to command the device ON and open the output to turn the device OFF.

3. 06 L-854 RADIO CONTROL METHODOLOGY

A. Existing L-854 radio control methodology shall remain. Provide new cable and antenna with mounting support including surge protection for the L-854 radio.

3. 07 BEACON RADIO CONTROL METHODOLOGY

A. Existing Beacon radio control methodology shall remain.

## END OF ITEM L-890

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# TECHNICAL SPECIFICATIONS

# DIVISION 31
# EARTHWORK

# SECTION 31 10 00 – EARTHWORK

## PART 1 - GENERAL

1.01 SUMMARY

A. Earthwork includes, but is not limited to; excavation, backfill, compaction and preparation of subgrade for the extent of work as indicated on Plans and herein specified.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. All work shall conform to Sections/Indexes of the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, Dated 2020, as amended.

B. Qualifications: Earthwork Contractor shall submit evidence of skill and not less than five (5) years specialized experience with earthwork operations.

C. Trench Safety Act/Standards: All trench excavation shall comply with the Florida Trench Safety Act (Sections 553.60-553.64, Florida Statutes) and the Occupational Safety and Health Administration's (OSHA) trench excavation safety standards, 29 C.F.R. s.1926.650, Subpart P, including all subsequent revisions or updates to Standards as adopted by the Department of Labor and Employment Security (DLES).

D. Reference Standards:

1. American Society for Testing and Materials (ASTM):

a. Referenced Standards.

2. American Association of State Highway and Transportation Officials (AASHTO):

a. Referenced Standards.

1.03 MATERIAL STORAGE

A. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

B. Locate and retain soil materials away from edge of excavations.

C. Dispose of excess soil and waste materials as herein specified.

1.04 PROJECT CONDITIONS

A. Use of Explosives: The use of explosives is NOT PERMITTED.

B. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights.

2. Operate warning lights as recommended by authorities having jurisdiction.

3. Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

## PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Refer to FDOT Section 120 – EXCAVATION AND EMBANKMENT.

B. Definitions:

1. Satisfactory soil materials are defined as those complying with AASHTO M145, soil classification Groups A-1, A-2-4, and A-3.

2. Unsatisfactory soil materials are those defined in AASHTO M145 soil classification Groups A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, and A-7; also peat and other highly organic soils.

C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, natural or crushed sand.

D. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2 inch sieve and not more than 5% passing a No. 4 sieve.

E. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock, or gravel larger than 2 inches in any dimension, debris, waste, vegetable, and other deleterious matter. Backfill and fill material shall contain no more than 5 percent by weight passing the No. 200 sieve.

## PART 3 - EXECUTION

3.01 EXCAVATION

A. Refer to FDOT Section 120 – EXCAVATION AND EMBANKMENT.

B. Earth excavation includes removal and disposal of obstructions visible on ground surface, and material of any classification indicated in data on subsurface conditions, and other materials encountered.

C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense. All remedial work due to unauthorized excavation shall meet the minimum requirements set forth in the Specifications.

D. Under footings, foundation bases, or retaining walls; fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Satisfactory soil materials may be used to bring elevations to proper position, when acceptable to Engineer.

E. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

~~3.02 ADDITIONAL EXCAVATION~~

~~A. When excavation has reached required subgrade elevations, notify Engineer who will make an inspection of conditions.~~

B. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Engineer.

C. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes to work.

3.03 STABILITY OF EXCAVATIONS

A. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

B. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.04 DEWATERING

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding Project Site and surrounding area.

B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations.

C. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

D. All surface and/or underground damage due to dewatering shall be repaired at Contractor's expense.

3.05 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

B. In excavating for footings and foundations, take care not to disturb bottom excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work. A density of 98% of the modified proctor dry density shall be obtained for a depth of 1-foot below the footing or foundation bottom. Perform compaction as necessary to achieve this criteria.

3.06 EXCAVATION FOR TRENCHES

A. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6 inches to 9 inches clearance on both sides of pipe or conduit.

B. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.

C. For pipes or conduits 5 inches or less in nominal size and for flat-bottomed multiple-duct conduit units, DO NOT excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.

D. For pipes or conduits 6 inches or larger in nominal size, tanks, and other mechanical/electrical work indicated to receive subbase, excavate to subbase depth indicated, or, if not otherwise indicated, to 6 inches below bottom of work to be supported.

E. Except as otherwise indicated, excavate for exterior waterbearing piping so top of piping is not less than 3 feet below finished grade.

~~F. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.~~

~~G. Backfill trenches with compacted satisfactory soil where trench excavations pass within 18 inches of wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place compacted satisfactory soil to level of bottom of adjacent footing.~~

~~H. DO NOT backfill trenches until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.~~

3.07 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated as follows:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils determined in accordance with ASTM D 1557 (AASHTO T-180):

a. Structures, Foundations, Footings, and Concrete Pavements: Compact top 24 inches of subgrade and each 12 inch layer of backfill or fill material at 98% maximum dry density.

b. Paved Asphalt Areas: Compact top 12 inches of subgrade and each layer of backfill or fill material at 98% maximum dry density.

c. Concrete Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material at 98% maximum dry density.

d. Lawn or Unpaved Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density. If lawn or planting areas are compacted more than 90%, condition must be corrected prior to planting operations.

B. Moisture Control: Where subgrade or layer of soil material is required to be moisture conditioned before compaction, apply water uniformly to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

C. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

3.08 BACKFILL AND FILL

A. General: Place satisfactory soil material in layers to required subgrade elevations, for each area classification listed below:
1. In excavations; use satisfactory excavated or borrow material.

2. Under Structure slabs; use subbase fill material.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade including, where applicable, damproofing, waterproofing, and perimeter insulation.

2. Inspection, testing, approval, and recording locations of underground utilities.

3. Removal of trash and debris.

4. Permanent or temporary horizontal bracing is in place on horizontal supported walls.

C. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fill. Grub the near surface soil of buried objects, roots, etc. Carefully replace all excavations with satisfactory soil placed and compacted in lifts. The prepared ground surface shall be approved by the Engineer before proceeding.

D. When existing ground surface has a density less than that specified herein under item 3.07 COMPACTION for particular area classification, break-up ground surface, pulverize, moisture-condition to near optimum moisture content, and compact to required depth and percentage of maximum density.

## 3.09 PLACEMENT AND COMPACTION

A. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. DO NOT place backfill or fill material on surfaces that are muddy or otherwise unsatisfactory in the opinion of the Engineer.

C. Place backfill and fill materials evenly adjacent to structures, and compact in lifts to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

## ~~3.10 GRADING~~

~~A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.~~

~~B. Grading Outside Structure Lines: Grade areas adjacent to structure lines to drain away from structures and to prevent ponding.~~

~~C. Finish surfaces free from irregular surface changes:~~

~~1. Walks: Shape surface of area under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevations.~~

~~D. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of + ¼ inch when tested with a 10 foot straightedge.~~

~~E. Compaction: Compact subgrade surfaces, existing ground after stripping, and all fill to the depth and percentage of maximum density for each area classification.~~

## 3.11 FIELD QUALITY CONTROL

A. The Owner's Materials and Testing Laboratory or designated Soils Engineer to perform soil testing and inspection services for quality control testing during earthwork operations.

B. The Engineer will be present during excavation work and will be responsible for judgments as to depth of excavation required and assessing excavated material as suitable or unsuitable for reuse under

this Contract. Comply with such direction from the Engineer.

C. Field density tests shall be taken by the Owner or the Owner's designee at locations and depths selected to endeavor to ensure that all backfill and fill is properly placed and compacted. All retesting required resulting from test reports indicating failure to meet required density shall be paid for by the Contractor.

D. Footing Subgrade: Test footing subgrade at intervals selected by the Engineer for compaction in accordance with these specifications.

E. If in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to the Owner.

~~3.12 MAINTENANCE~~

~~A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.~~

~~B. Repair and re-establish grades in settled, eroded, and rutted areas at specified tolerances by using satisfactory soils placed and compacted in lifts.~~

~~C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, and compact to required density prior to further construction.~~

3.13 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash.

## END OF SECTION 31 10 00

# SECTION 31 31 16 - TERMITE TREATMENT

## PART 1 – GENERAL

1.01 WORK INCLUDED

A. Provide soil treatment for termite control at all concrete slabs and foundations to be developed into occupied areas of the building(s).

B. Related Sections include the following:

1. Division 3 Section “Cast-In-Place Concrete” for concrete work.

2. Division 7 Section “Under-Slab Vapor Barrier” for vapor barrier work.

1.02 QUALITY ASSURANCE

A. Applicator's Qualifications: Engage a professional pest control operator, currently licensed in the State of Florida accordance with regulations of governing authorities for application of soil treatment solution.

B. In addition to requirements of this Specification, comply with manufacturer's published instructions and current recommendations for the Work, including preparation of substrate and application.

1.03 SUBMITTALS

A. Product Data: Submit the following:

1. Manufacturer's technical data, complete with written substrate preparation and soil treatment application instructions. Include EPA-Registered Label.

2. Material Safety Data Sheets (MSDS).

B. Applicator’s Qualifications: Submit the following:

1. Documented evidence of applicator’s qualifications.

2. A copy of the applicator’s current state license.

C. Warranty: Submit a current specimen copy of the specified warranty.

1.04 PROJECT CONDITIONS

A. Application Restrictions: Comply with the following:

1. Do not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations.

2. To ensure penetration, do not apply soil treatment to excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

1.05 WARRANTY

A. Special Project Warranty: Provide a written warranty, signed by both the applicator and Contractor, certifying that applied soil treatment will prevent infestation of subterranean termites and, that if subterranean termite activity is discovered during warranty period, Contractor will re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Duration: Five (5) years from the date of treatment.

## PART 2 - PRODUCTS

2.01 SOIL TREATMENT SOLUTION

A. General: Provide an EPA-Registered emulsible, concentrated termiticide that dilutes with water, specially formulated to prevent termite infestation. Fuel oil will not be permitted as a diluent.

1. Dilute with water to concentration level compliant with manufacturer's written instructions.

2. Use only soil treatment solutions that are not injurious to plants.

B. Products: Provide one of the following products:

1. "Dragnet FT" permethrine; FMC Corp.

2. "Prevail FT" cypermethrine; FMC Corp.

3. "Demon TC" cypermethrine; Zeneca Professional Products.

4. "Prelude" permethrine; Zeneca Professional Products.

5. Or Approved Equal.

## PART 3 - EXECUTION

3.01 SOIL TREATMENT CRITERIA

A. A permanent sign which identifies the soil treatment applicator and the need for re-inspection and treatment contract renewal shall be provided. The sign shall be posted near the electrical panel.

B. Condensate and roof downspouts shall discharge at least 1'-0" away from the building side walls.

C. Irrigation/sprinkler system including all risers and spray heads shall not be installed within 1'-0" of the building's side walls.

D. To provide for inspection for termite infestation, between wall coverings and final earth grade shall not be less than 6-inches.

E. Initial treatment shall be performed after all excavation and backfill is complete.

F. Soil distribution after the initial treatment shall be retreated including spaces boxed or formed.

G. Boxed areas in concrete floors for subsequent installation of traps, etc., shall be made with permanent metal or plastic forms. Permanent forms shall be of a size and depth that will eliminate the disturbance of soil after the initial treatment.

H. A minimum 6-mil vapor barrier shall be installed to protect against rainfall dilution. If rainfall occurs before vapor barrier placement, re-treatment is required.

I. Concrete over placement and mortar along the foundation perimeter shall be removed before application of soil treatment.

J. Soil treatment shall be applied under all exterior concrete or grade within 1'-0" of the structural sidewalls.

K. An exterior vertical chemical barrier shall be installed after construction is complete including landscaping and irrigation. All soil that is disturbed after the treatment barrier is applied shall be re-treated.

L. A Certificate of Compliance shall be issued to the Building Department by a Licensed Pest Control Company. The Certificate of Compliance shall state, "THE BUILDING HAS RECEIVED A COMPLETE TREATMENT FOR THE PREVENTION OF SUBTERRANEAN TERMITES. THE TREATMENT IS IN ACCORDANCE WITH THE RULES AND LAWS OF THE FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER AFFAIRS."

M. After all Work has been completed, loose wood and fill shall be removed from below and within 1'-0" of the building. This includes all grade stakes, tub trap boxes, forms, shoring or other cellulose containing material.

N. No wood, vegetation, stumps, cardboard, trash, etc., shall be buried within 15'-0" of any building or proposed building.

3.02 APPLICATION

A. Surface Preparation: Remove foreign matter that could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Soil treatment solutions may be applied before placement of compacted fill under slabs, if recommended by soil treatment solution manufacturer.

B. Application Rates: Apply soil treatment solution in accordance with termiticide label directions.

C. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities.

D. Post signs in areas of application warning workers that soil treatment solutions have been applied. Remove signs when areas are covered by other construction.

E. Re-apply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

**END OF SECTION 31 31 16**

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# APPENDIX A

# PRE-DEMOLITION ASBESTOS & LEAD-BASED PAINT SURVEY REPORT

# Pre-Demolition Asbestos & Lead-Based Paint Survey Report-

St. Petersburg-Clearwater International Airport - Electrical Vault
14700 Terminal Boulevard
Clearwater, Florida 33762

July 27, 2020

Terracon Project No. H4207249


**Prepared for:**
BOARD OF COUNTY COMMISSIONERS - PINELLAS COUNTY
PO Box 2438
Clearwater, Florida 33757

**Prepared by:**
Terracon Consultants, Inc.
Tampa, Florida

July 27, 2020

Board of County Commissioners – Pinellas County
PO Box 2438
Clearwater, Florida 33757

Attn: Michael Iguina
P: 954.740.9731
E: miguina@fly2pie.com

Re: **Report of Pre-Demolition Asbestos and Lead-Based Paint Survey**
St. Petersburg-Clearwater International Airport - Electrical Vault
14700 Terminal Boulevard
Clearwater, Florida 33762
Terracon Project No.: H4207249

Mr. Iguina:

Terracon Consultants, Inc. (Terracon) is pleased to submit the attached report for the above referenced building to Board of County Commissioners Pinellas County. The purpose of this report is to present the results of the survey performed on July 21, 2020. This survey was conducted in general accordance with our Proposal PH4207249, dated July 19, 2020. We understand that this limited asbestos & limited lead-based paint sampling report was requested due to planned demolition of the Electrical Vault.

Based on the laboratory results, asbestos **was not** detected in the materials assessed and Lead-Based paint **was** detected in coatings assessed during our survey; please refer to the attached report for details.

Terracon appreciates the opportunity to provide this service to Board of County Commissioners Pinellas County. If you have any questions regarding this report, or if you need assistance with project oversight and sampling during demolition, please contact the undersigned at 813-221-0500.

Sincerely,
**Terracon Consultants, Inc.**
*Florida Asbestos Business License Number ZA-337*

Peter MacKay
Licensed Asbestos Inspector
Project Industrial Hygienist
EPA Certified Lead-Based Paint Inspector: LBP-I-I182484-1

Tom Holley, CHMM, CIH, CSP
Licensed Asbestos Consultant AX-75
Authorized Project Reviewer

# TABLE OF CONTENTS

# PRE-DEMOLITION ASBESTOS AND LEAD-BASED PAINT SURVEY REPORT

## St. Petersburg-Clearwater International Airport – Electrical Vault
## 14700 Terminal Boulevard
## Clearwater, Florida 33762
## Terracon Project No.: H4207249

**July 27, 2020**

# 1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) conducted a Pre-Demolition Asbestos Survey & Lead-Based Paint Survey of the accessible areas of the Vault at the St. Petersburg-Clearwater International Airport - Electrical Vault in Clearwater, Florida. The survey was performed at your request to assess potential hazardous materials that may be present to accommodate the planned demolition activities at the facility.

The survey was conducted on July 21, 2020 by Terracon representative Mr. Peter MacKay, an AHERA-accredited asbestos inspectors in general accordance with Proposal PH4207249, dated July 19, 2020. Applicable licenses and certifications are presented in Appendix F.

Building components were surveyed and homogeneous areas of suspect asbestos-containing materials (ACM) and lead-based paint (LBP) were visually identified and documented. Although reasonable effort was made to survey accessible suspect materials, additional suspect but un-sampled materials could be located in walls, in voids, below the ground or in other concealed areas. Asbestos sampling was performed in general accordance with the United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 763 Subpart E 763, known as the Asbestos Hazard Emergency Response Act (AHERA). Suspect LBP samples were obtained from representative surfaces potentially containing lead coatings. Selected photographs are presented in Appendix E.

## 1.1 Project Objective

Terracon's services were performed to accommodate planned demolition activities and to satisfy requirements of the USEPA regulation 40 CFR 61, Subpart M, National Emission Standards for Hazardous Air Pollutants (NESHAP). NESHAP regulations prohibit the release of asbestos fibers to the atmosphere during renovation or demolition activities. The asbestos NESHAP requires that potentially regulated ACM (RACM) be identified, classified and quantified prior to planned disturbances or demolition activities. Lead paint testing was performed to comply with applicable sections of the OSHA Lead Standard (29 CFR 1926.62) for disturbance of paint with lead that will be encountered during renovation or demolition activities.

### 1.2 Reliance

This report is for the exclusive use of Board of County Commissioners Pinellas County for the project being discussed. Reliance by any other party on this report is prohibited without written authorization of Terracon and Board of County Commissioners Pinellas County. Reliance on this report by Board of County Commissioners Pinellas County and all authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, this report and the existing agreement between Board of County Commissioners Pinellas County and Terracon. The limitations of liability defined in Terracon's Agreement for Services is the aggregate limit of Terracon's liability to Board of County Commissioners Pinellas County.

## 2.0 BUILDING DESCRIPTION

Terracon understands that the building is scheduled for demolition to accommodate new construction. The approximately 760 square foot, single-story structure consists of a concrete slab on grade with concrete block interior and exterior walls, with a built-up roof on a concrete roof deck. No interior finish materials were utilized in the construction of the structure. Heating and cooling is provided by a single mini-split HVAC unit. Selected photographs are presented in Appendix E.

## 3.0 ASBESTOS FIELD ACTIVITIES

The survey was conducted on July 21, 2020 by Terracon representative Mr. Peter MacKay, an AHERA-accredited asbestos inspector. A copy of the inspector certificate and applicable licenses are attached as Appendix F. The survey was conducted in general accordance with the sample collection protocols established in USEPA 40 CFR Part 763 Subpart E 763.86, AHERA. A summary of survey activities is provided below.

### 3.1 Visual Assessment

Survey activities were initiated with limited visual observations of the accessible designated areas to identify homogeneous areas of suspect ACM. A homogeneous area (HA) consists of building materials that appear similar throughout in terms of color and texture with consideration given to the date of application. The assessment was conducted in readily accessible areas of the structure.

### 3.2 Physical Assessment

A physical assessment of each homogeneous area of suspect ACM was conducted to assess the friability and condition of the materials. A friable material is defined by the EPA as a material which can be crumbled, pulverized or reduced to powder by hand pressure when dry. Friability was assessed by physically touching suspect materials.

### 3.3 Sample Collection

Based on results of the visual observation, bulk samples of suspect ACM were collected in general accordance with AHERA sampling protocols. Samples of suspect materials were collected randomly selected locations in each homogeneous area. Bulk samples were collected using wet methods as applicable to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

The selection of sample locations and frequency of sampling were based on Terracon's observations and the assumption that like materials in the same area are homogeneous in content.

A total of twenty-seven (27) bulk samples were collected by Terracon from twelve (12) homogeneous areas of suspect ACM. A listing of suspect ACM observed and sampled during the survey is provided in Appendix A. Asbestos laboratory data is presented in Appendix C.

### 3.4 Sample Analysis

Bulk samples were submitted under secure chain of custody protocols to Cates Laboratories, Inc. (Cates) for analysis by polarized light microscopy with dispersion staining techniques per USEPA methodology 600/R-93/116. The percentage of asbestos, where applicable, was determined by microscopic visual estimation. Cates is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) Accreditation No. 200569-0.

## 4.0 LEAD-BASED PAINT FIELD ACTIVITES

### 4.1 Visual Observations

The LBP survey was limited to readily observable and accessible surfaces. Terracon cannot guarantee a building or property to be LBP free as the possibility exists that LBP coated surfaces may be hidden from sight or in inaccessible locations, or the homogeneous construction areas identified may not be truly homogeneous. **This limited LBP survey was not performed to the HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing standards or applicable to USEPA 40 CFR 745 requirements.** It should be understood that this limited LBP survey is not considered to be comprehensive in nature, and the results are not intended to be used to determine lead hazards, develop abatement plans, or prepare detailed cost estimates for abatement.

### 4.2 Visual Assessment

A visual assessment of each unique combination, defined as a color, component and substrate, of suspect LBP was conducted in addition to an assessment the of the paint condition.

### 4.3 Sample Collection

A total of seven (7) chip samples of suspect LBP were collected from various painted components. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

### 4.4 Sample Analysis

Samples were submitted under chain of custody to EMSL Analytical Inc. for analysis by flame atomic absorption spectrometry per EPA SW-846/3050B/7000B. EMSL is accredited under the Environmental Lead Laboratory Accreditation Program (ELLAP) (Accreditation No. 100194).

## 5.0 ASBESTOS REGULATORY OVERVIEW

The asbestos NESHAP (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. The NESHAP regulation also requires the identification and classification of existing ACM according to friability prior to demolition or renovation activity.
Under NESHAP, asbestos-containing building materials are classified as:

1. Friable ACM, or
2. Category I Non-Friable ACM, or
3. Category II Non-Friable ACM.

Friable materials are those that, when dry, may be crumbled, pulverized or reduced to powder by hand pressure. Category I Non-Friable ACM includes packings, gaskets, resilient floor coverings and asphalt roofing products containing more than 1% asbestos. Category II Non-Friable ACM are any materials other than Category I Non-Friable ACM that contain more than 1% asbestos.

Under NESHAP, Regulated Asbestos-Containing Materials (RACM are classified as:

1. Friable ACM,
2. Category I Non-Friable ACM that is in poor condition and/or has become friable,
3. Category I Non-Friable ACM that will or has been subjected to sanding, grinding, cutting or abrading
4. Category II Non-Friable ACM that has a high probability of becoming or has become crumbled, pulverized or reduced to powder by the forces expected to act upon the material in the course of renovation or demolition operations.

In the State of Florida, asbestos activities are regulated by the Florida Department of Environmental Protection (FDEP). Some counties have developed an enforcement division to carry out the responsibilities of the FDEP and have developed environmental and asbestos ordinances in which additional compliance is required. Even though the facility is located in Pinellas County Florida the NESHAP regulation compliance for a Pinellas County

program/department are administered by the Florida Department of Environmental Protection, Southwest District office in Temple Terrace, Florida.

Per the NESHAP, RACM must be removed prior to renovation or demolition activities that will disturb the materials. Removal of the ACM or RACM must be conducted by a State of Florida-licensed asbestos abatement contractor, in compliance with Florida Statute (F.S) 469.001-014. In addition, third party air monitoring should be performed during and following the abatement.

The Occupational Safety and Health Administration (OSHA) Asbestos standard for construction (29 CFR 1926.1101) regulates employee workplace exposure to asbestos. The OSHA standard has (2) Permissible Exposure Limits (PEL) that require employee exposure to airborne asbestos fibers be maintained below 0.1 asbestos fibers per cubic centimeter of air (0.1 f/cc) for an 8-hour Time-Weighted Average (8-Hr. TWA) and 1.0 f/cc for a 30-minute TWA (Excursion Limit). The OSHA standard classifies construction and maintenance activities which could disturb ACM and specifies work practices and precautions which employers must follow when engaging in each class of regulated work.

## 6.0 LEAD-BASED PAINT REGULATORY OVERVIEW

Lead is regulated by the USEPA, HUD, FDEP and OSHA. The USEPA and FDEP regulate lead use, removal, and disposal, and OSHA regulates lead exposure to workers. The USEPA defines LBP as paint, varnish, stain, or other applied coating that contains lead equal to or greater than 1.0 mg/cm$^2$, 5,000 mg/kg, or 0.5% by dry weight as determined by laboratory analysis. For the purpose of the OSHA lead standard, lead includes any detectable concentrations of metallic lead, all inorganic lead compounds, and organic lead soaps. A synopsis of the OSHA regulations (29 CFR 1926.62) and the applicability are as follows:

The OSHA Lead Standard for Construction (29 CFR 1926.62) applies to all construction work where an employee may be occupationally exposed to lead. All work related to construction, alteration, or repair (including painting and decorating) is included. The Lead-in-Construction standard applies to any detectable concentration of lead in paint, as even small concentrations of lead can result in unacceptable employee exposures depending upon on the method of disturbance-removal and other workplace conditions.

Under this standard, construction includes, but is not limited to, the following:

- Demolition or salvage of structures where lead or materials containing lead are present
- Removal or encapsulation of materials containing lead
- New construction, alteration, repair, or renovation of structures, substrates, or portions containing lead, or materials containing lead
- Installation of products containing lead
- Lead contamination/emergency clean-up

- Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed
- Maintenance operations associated with construction activities described above.

Employers must assure that no employee will be exposed to lead at concentrations greater than the PEL of 50 micrograms per cubic meter ($\mu g/m^3$) averaged over an eight-hour period without adequate protection. The OSHA standard also establishes an action level of 30 $\mu g/m^3$, which if exceeded, triggers certain requirements, including periodic exposure monitoring and medical monitoring.

USEPA regulates disposal of hazardous materials. The USEPA has stated that components removed with intact LBP that is not delaminating from the substrate may be disposed as general demolition debris. If the LBP is stripped from components, or if it is delaminating from the substrate, the waste may be subject to hazardous waste rules [i.e., Toxicity Characteristic Leachate Procedure (TCLP)].

# 7.0 FINDINGS AND RECOMMENDATIONS – ASBESTOS

## 7.1 Findings

Based on the results of laboratory analysis, asbestos **was not** detected in samples collected from the designated restroom structures. The laboratory analytical report is included as Appendix C.

It should be noted that suspect materials, other than those identified during this survey may exist within the designated structure. Should suspect materials other than those which were identified during this survey be uncovered prior to or during the demolition process, those materials should be assumed asbestos-containing until sampling and analysis can confirm or deny their asbestos content.

## 7.2 Recommendations

Even though **no** asbestos was detected in the samples collected in the project scope, no recommendations are provided for asbestos, other than maintaining a copy of this report on-site during the renovation activities. However you may want to directly contact the Florida Department of Environmental Protection, Southwest office (813-470-5700) for confirmation of their regulatory requirements, including the 10-day notification.

# 8.0 FINDINGS AND RECOMMENDATIONS – LBP

## 8.1 Findings

Based on a review of the analytical results, quantifiable concentrations of above the laboratory reporting limit **were detected** in one (1) of the seven (7) paint chip samples collected during the survey. The condition of the paint was documented to be fair to poor.

Please refer to Appendix B for a summary of the sample descriptions, locations and results. The laboratory analytical results are included in Appendix D.

## 8.2 Recommendations

Disturbance of any of the coatings and/or components found to contain detectable levels of lead would require such activities be conducted in compliance with the requirements of the OSHA Lead Standard for Construction (29 CFR 1926.62). As such, personnel disturbing materials/components would need to have the OSHA level required training, comply with the work practices, levels of potential exposure documented and compared to the Action and Permissible Exposure Levels of 30 µg/$m^3$ and 50 µg/$m^3$ respectively. In addition, disposal of the waste materials would be tested utilizing the Toxicity characteristic leaching procedure (TCLP) to document lead content and compared to the EPA and FDEP threshold of 5.0 mg/Liter and disposed of accordingly.

# 9.0 LIMITATIONS/GENERAL COMMENTS

This pre-demolition asbestos & lead-based paint sampling was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. The results, findings, conclusions and recommendations expressed in this report are based on conditions observed during our survey of the designated areas. The information contained in this report is relevant to the date on which this survey was performed and should not be relied upon to represent conditions at a later date.

This report has been prepared on behalf of and exclusively for use by Board of County Commissioners Pinellas County for specific application to their project as discussed. This report is not a bidding document. Contractors or consultants reviewing this report must draw their own conclusions regarding further investigation or remediation deemed necessary. Terracon does not warrant the work of regulatory agencies, laboratories or other third parties supplying information which may have been used in the preparation of this report. No warranty, express or implied is made.

# APPENDIX A
# PRE-DEMOLITION ASBESTOS AND LEAD-BASED PAINT SURVEY REPORT

## ST. PETERSBURG-CLEARWATER INTERNATIONAL AIRPORT – ELECTRICAL VAULT
## 14700 TERMINAL BOULEVARD
## CLEARWATER, FLORIDA 33762
## TERRACON PROJECT NO.: H4207249

### ASBESTOS SURVEY SAMPLE LOCATION SUMMARY

| HA | Sample No. | Sample Description | Sample Location | Layer Description | Sample Results |
|---|---|---|---|---|---|
| R1 | R1-1 | Built-Up Roof w/Gravel - Vault Roof, High Roof | Vault Roof, High Roof | Roofing Membrane | None Detected |
| | | | | Roofing Insulation | None Detected |
| | R1-2 | | Vault Roof, Low Roof | Roofing Membrane | None Detected |
| | | | | Roofing Insulation | None Detected |
| MS1 | MS1-3 | Lightning Protection Base Mastic (gray) | Vault Roof, High Roof | Grey Mastic | None Detected |
| | MS1-4 | | Vault Roof, Low Roof | Grey Mastic | None Detected |
| W1 | W1-5 | Exterior Wall Stucco (sand texture) | Vault Roof Exterior, Northeast | Paint Texture | None Detected |
| | | | | Stucco | None Detected |
| | W1-6 | | Vault Roof Exterior, Northwest | Paint Texture | None Detected |
| | | | | Stucco | None Detected |
| | W1-7 | | Vault Roof Exterior, Southwest | Paint Texture | None Detected |
| | | | | Stucco | None Detected |
| | W1-8 | | Vault Roof Exterior, South, Center | Paint Texture | None Detected |
| | | | | Stucco | None Detected |
| | W1-9 | | Vault Roof Exterior, Southeast | Paint Texture | None Detected |
| | | | | Stucco | None Detected |
| W2 | W2-10 | Concrete Masonry Unit Walls | Vault Roof Exterior, Northwest | Filler/Texture | None Detected |
| | | | | CMU Block | None Detected |
| | W2-11 | | Vault Roof Exterior, Southeast | Filler/Texture | None Detected |
| | | | | CMU Block | None Detected |
| MS2 | MS2-12 | Exterior Wall Caulk (white) Expansion Joint | Vault Roof Exterior, North | Caulking | None Detected |
| | MS2-13 | | | Caulking | None Detected |
| MS3 | MS3-14 | Exterior Wall Caulk (gray) Wall/Slab Joint | Vault, North | Caulking | None Detected |
| | MS3-15 | | Vault, South | Caulking | None Detected |
| MS4 | MS4-16 | Vent Louver Caulk (white) | Vault, Southeast | Caulking | None Detected |
| | MS4-17 | | | Caulking | None Detected |
| MS5 | MS5-18 | HVAC Metal Duct Caulk (grey) | Vault, Southwest | Caulking | None Detected |
| | MS5-19 | | | Caulking | None Detected |
| MS6 | MS6-20 | Firestop Putty (red) | Vault Interior, Center | Firestop | None Detected |
| | MS6-21 | | | Firestop | None Detected |

| HA | Sample No. | Sample Description | Sample Location | Layer Description | Sample Results |
|---|---|---|---|---|---|
| F1 | F1-22 | Foundation Slab Concrete | Vault Interior, East Room | Concrete | None Detected |
| | F1-23 | | Vault Interior, West Room | Concrete | None Detected |
| MS7 | MS7-24 | Expansion Joint Material (black) | Vault Interior, Center Room | Expansion Jt. Material | None Detected |
| | MS7-25 | | | Expansion Jt. Material | None Detected |
| W3 | W3-26 | Glass Block Grout | Vault, West | Grout | None Detected |
| | W3-27 | | Vault, West | Grout | None Detected |

# APPENDIX B

# PRE-DEMOLITION ASBESTOS AND LEAD-BASED PAINT SURVEY REPORT

## ST. PETERSBURG-CLEARWATER INTERNATIONAL AIRPORT – ELECTRICAL VAULT

## 14700 TERMINAL BOULEVARD

## CLEARWATER, FLORIDA 33762

## TERRACON PPROJECT NO.: H4207249

### LEAD-BASED PAINT SUMMARY TABLE

| Test No. | Sample Location | Component | Color | Substrate | Condition | Lab Result (% wt.) |
|---|---|---|---|---|---|---|
| LBP-1 | Vault – Exterior – North | Wall | Gray | Stucco | Fair | <0.010 |
| LBP-2 | Vault – Interior – East Room | West Wall | Gray | Concrete Masonry Unit | Fair | <0.0080 |
| LBP-3 | Vault – Interior – East Room | Floor | Gray | Concrete | Poor | <0.0080 |
| LBP-4 | Vault – Interior – East Room | Wall | Cream | Concrete Masonry Unit | Poor | <0.0080 |
| LBP-5 | Vault – Interior – East Room | Door | Gray | Metal | Fair | <0.010 |
| LBP-6 | Vault – Interior – East Room | Door Frame | Gray | Metal | Fair | <0.0080 |
| **LBP-7** | **Vault – Interior – West Room** | **Wall** | **White** | **Concrete Masonry Unit** | **Fair** | **0.22** |

Results in **bold** indicate quantifiable concentrations of lead

# APPENDIX C

# ASBESTOS ANALYTICAL LABORATORY RESULTS

# PLM REPORT SUMMARY

**Cates Laboratories**
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): St. Petersburg - Clearwater International Airport (PIE)
Project (Line 2): Electrical Vault, 14700 Terminal Blvd., Clearwater, FL 33762
Project No: H4207249
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-23640
Set No.: 34852
Report Date: 7/23/2020
Sample Date: 7/21/2020



On 7/22/2020, twenty-seven (27) bulk samples were submitted by Mr. Pete MacKay of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

| Lab Sample No. | Client Field I.D. | Sample Description/Location | Asbestos Content |
|---|---|---|---|
| CL840880 | R1-1 | Built-Up Roof w/Gravel - Vault Roof, High Roof | None Detected - Roofing Membrane<br>None Detected - Roofing Insulation |
| CL840881 | R1-2 | Built-Up Roof w/Gravel - Vault Roof, Low Roof | None Detected - Roofing Membrane<br>None Detected - Roofing Insulation |
| CL840882 | MS1-3 | Lightning Protection Base Mastic (grey) - Vault Roof, High Roof | None Detected |
| CL840883 | MS1-4 | Lightning Protection Base Mastic (grey) - Vault Roof, Low Roof | None Detected |
| CL840884 | W1-5 | Exterior Wall Stucco (sand texture) - Vault Roof Exterior, Northeast | None Detected - Paint Texture<br>None Detected - Stucco |
| CL840885 | W1-6 | Exterior Wall Stucco (sand texture) - Vault Roof Exterior, Northwest | None Detected - Paint Texture<br>None Detected - Stucco |
| CL840886 | W1-7 | Exterior Wall Stucco (sand texture) - Vault Roof Exterior, Southwest | None Detected - Paint Texture<br>None Detected - Stucco |
| CL840887 | W1-8 | Exterior Wall Stucco (sand texture) - Vault Roof Exterior, South, Center | None Detected - Paint Texture<br>None Detected - Stucco |
| CL840888 | W1-9 | Exterior Wall Stucco (sand texture) - Vault Roof Exterior, Southeast | None Detected - Paint Texture<br>None Detected - Stucco |
| CL840889 | W2-10 | Concrete Masonry Unit Walls - Vault Roof Exterior, Northwest | None Detected - Filler/Texture<br>None Detected - CMU Block |
| CL840890 | W2-11 | Concrete Masonry Unit Walls - Vault Roof Exterior, Southeast | None Detected - Filler/Texture<br>None Detected - CMU Block |
| CL840891 | MS2-12 | Exterior Wall Caulk (white) Expansion Joint - Vault Roof Exterior, North | None Detected |
| CL840892 | MS2-13 | Exterior Wall Caulk (white) Expansion Joint - Vault Roof Exterior, North | None Detected |
| CL840893 | MS3-14 | Exterior Wall Caulk (grey) Wall/Slab Joint - Vault, North | None Detected |
| CL840894 | MS3-15 | Exterior Wall Caulk (grey) Wall/Slab Joint - Vault, South | None Detected |
| CL840895 | MS4-16 | Vent Louver Caulk (white) - Vault, Southeast | None Detected |

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

# PLM REPORT SUMMARY

**Cates Laboratories**
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

Client: Terracon
Project (Line 1): St. Petersburg - Clearwater International Airport (PIE)
Project (Line 2): Electrical Vault, 14700 Terminal Blvd., Clearwater, FL 33762
Project No: H4207249
Identification: Asbestos, Bulk Sample Analysis
Test Method: Polarized Light Microscopy/Dispersion Staining (PLM/DS)
EPA Method 600/R-93/116

Lab Job No.: PLM-23640
Set No.: 34852
Report Date: 7/23/2020
Sample Date: 7/21/2020



On 7/22/2020, twenty-seven (27) bulk samples were submitted by Mr. Pete MacKay of Terracon for asbestos analysis by PLM/DS. Copies of the lab data sheets are attached; additional information may be found therein. The results are summarized below:

| Lab Sample No. | Client Field I.D. | Sample Description/Location | Asbestos Content |
|---|---|---|---|
| CL840896 | MS4-17 | Vent Louver Caulk (white) - Vault, Southeast | None Detected |
| CL840897 | MS5-18 | HVAC Metal Duct Caulk (grey) - Vault, Southwest | None Detected |
| CL840898 | MS5-19 | HVAC Metal Duct Caulk (grey) - Vault, Southwest | None Detected |
| CL840899 | MS6-20 | Firestop Putty (red) - Vault Interior, Center | None Detected |
| CL840900 | MS6-21 | Firestop Putty (red) - Vault Interior, Center | None Detected |
| CL840901 | F1-22 | Foundation Slab Concrete - Vault Interior, East Room | None Detected |
| CL840902 | F1-23 | Foundation Slab Concrete - Vault Interior, West Room | None Detected |
| CL840903 | MS7-24 | Expansion Joint Material (black) - Vault Interior, Center Room | None Detected |
| CL840904 | MS7-25 | Expansion Joint Material (black) - Vault Interior, Center Room | None Detected |
| CL840905 | W3-26 | Glass Block Grout - Vault, West | None Detected |
| CL840906 | W3-27 | Glass Block Grout - Vault, West | None Detected |

These samples were analyzed by layers. The overall percent asbestos for the sample is reported when relevant. The EPA considers a material to be asbestos containing only if it contains greater than one percent asbestos by Calibrated Visual Area Estimation (CVAE). EPA regulations also indicate that Regulated Asbestos Containing Materials (RACM) – materials that are friable or may become friable – be further analyzed by point counting when the results indicate less than ten percent asbestos by CVAE. CatesLab utilizes CVAE on a routine basis and does not include point counting unless specifically requested by the client. The results may not be reproduced except in full.

# PLM REPORT SUMMARY

**Cates Laboratories**
1339 Motor Circle
Dallas, Texas 75207 (214) 920-5006

NVLAP Lab No. 200569-0
TDSHS License No. 30-0287

| | | | |
|---|---|---|---|
| Client: | Terracon | Lab Job No.: | PLM-23640 |
| Project (Line 1): | St. Petersburg - Clearwater International Airport (PIE) | Set No.: | 34852 |
| Project (Line 2): | Electrical Vault, 14700 Terminal Blvd., Clearwater, FL 33762 | Report Date: | 7/23/2020 |
| Project No: | H4207249 | Sample Date: | 7/21/2020 |
| Identification: | Asbestos, Bulk Sample Analysis | | |
| Test Method: | Polarized Light Microscopy/Dispersion Staining (PLM/DS)<br>EPA Method 600/R-93/116 | | |



On 7/22/2020, twenty-seven (27) bulk samples were submitted by Mr. Pete MacKay of Terracon for asbestos analysis by PLM/DS.
Copies of the lab data sheets are attached; additional information may be found therein.

## STATEMENT OF LABORATORY ACCREDITATION

The samples were analyzed in general accordance with the procedures outlined in the Method for the Determination of Asbestos in Bulk Building Materials, EPA/600/R-93/116 or the U.S. Environmental Protection Agency EPA 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, by polarized light microscopy. The results of each bulk sample relate only to the material tested and the results shall not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Specific questions concerning bulk sample results shall be directed to the Laboratory Director.

Analyst: Kathy Schosek

Laboratory Director: John R. Cates, P.G.

Approved Signatory:

NVLAP LAB CODE 200569-0

# APPENDIX D

# LEAD BASED PAINT ANALYTICAL LABORATORY RESULTS

**EMSL Analytical, Inc.**
**200 Route 130 North, Cinnaminson, NJ 08077**
Phone/Fax: (856) 303-2500 / (856) 786-5974
http://www.EMSL.com cinnaminsonleadlab@emsl.com

| | |
|---|---|
| EMSL Order: | 202006513 |
| CustomerID: | TERA72 |
| CustomerPO: | H4207249 |
| ProjectID: | |

Attn: **Pete MacKay**
**Terracon Consultants, Inc.**
**5463 West Waters Avenue**
**Suite 830**
**Tampa, FL 33634**

| | |
|---|---|
| Phone: | (813) 626-1730 |
| Fax: | (813) 626-1452 |
| Received: | 07/22/20 10:40 AM |
| Collected: | 7/21/2020 |

Project: **H4207249 - PIE Electrical Vault**

# Test Report: Lead in Paint Chips by Flame AAS (SW 846 3050B/7000B)*

| *Client Sample Description* | *Lab ID* | *Collected* | *Analyzed* | *Weight* | *Lead Concentration* |
|---|---|---|---|---|---|
| LBP-1 | *202006513-0001A* | 7/21/2020 | 7/24/2020 | 0.1928 g | <0.010 % wt |
| | Site: vault - exterior - north - wall - gray | | | | |
| LBP-2 | *202006513-0002A* | 7/21/2020 | 7/24/2020 | 0.2545 g | <0.0080 % wt |
| | Site: vault - interior - east room / w.wall / wall / gray | | | | |
| LBP-3 | *202006513-0003A* | 7/21/2020 | 7/24/2020 | 0.2977 g | <0.0080 % wt |
| | Site: vault - interior - floor - E.room / floor - gray | | | | |
| LBP-4 | *202006513-0004A* | 7/21/2020 | 7/24/2020 | 0.2552 g | <0.0080 % wt |
| | Site: vault - interior - east room - wall / cream | | | | |
| LBP-5 | *202006513-0005* | 7/21/2020 | 7/23/2020 | 0.1986 g | <0.010 % wt |
| | Site: vault- interior - east room - door - gray | | | | |
| LBP-6 | *202006513-0006* | 7/21/2020 | 7/23/2020 | 0.2629 g | <0.0080 % wt |
| | Site: vault - interior - east room - door frame - gray | | | | |
| LBP-7 | *202006513-0007A* | 7/21/2020 | 7/24/2020 | 0.2842 g | 0.22 % wt |
| | Site: vault - interior - west room - wall - white | | | | |

The sample duplicate RPD for samples -0005 and -0006 fell outside the control limits. All other QC results met criteria.

Phillip Worby, Lead Laboratory Manager
or other approved signatory



Initial report from 07/24/2020 16:24:01

# APPENDIX E

# REPRESENTATIVE PHOTOGRAPHS

**Photo #1** Vault – Exterior – Representative Overview

**Photo #2** Vault – Exterior – Representative Overview

**Photo #3** Vault – Exterior – Representative Overview

**Photo #4** Vault – Exterior – Representative Overview

**Photo #5** Vault – Roof – Representative Overview

**Photo #6** Vault – Roof – Representative Overview

**Photo #7** Vault – Interior – East Room – Representative Overview

**Photo #8** Vault – Interior – East Room – Representative Overview

**Photo #9** Vault – Interior – Center Room – Representative Overview


**Photo #10** Vault – Interior – Center Room – Representative Overview

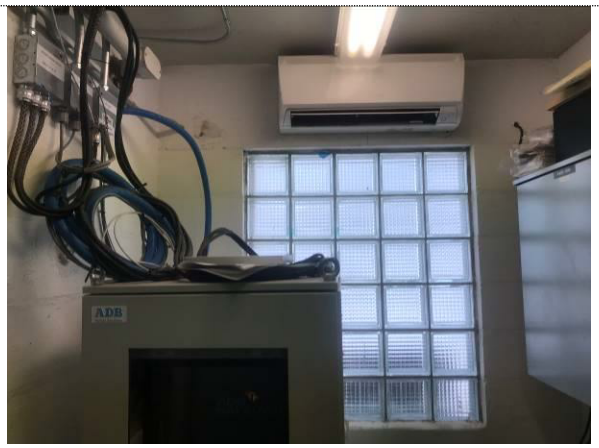

**Photo #11** Vault – Interior – West Room – Representative Overview

**Photo #12** Vault – Interior – West Room – Representative Overview

| | | |
|---|---|---|
|  | | |
| **Photo #13** Vault – Interior – West Room – South Wall – Concrete Masonry Unit Walls – Sample Location (**LBP-7**) | | |

# APPENDIX F

# LICENSES AND CERTIFICATIONS

Ron DeSantis, Governor

Halsey Beshears, Secretary

Florida dbpr

**STATE OF FLORIDA**
**DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION**

**ASBESTOS LICENSING UNIT**

THE ASBESTOS BUSINESS ORGANIZATION HEREIN IS LICENSED UNDER THE PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

## TERRACON CONSULTANTS INC

MICHAEL W SCHRUM
1675 LEE ROAD
WINTER PARK FL 32789

**LICENSE NUMBER: ZA337**
**EXPIRATION DATE: NOVEMBER 30, 2021**

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RICK SCOTT, GOVERNOR

JONATHAN ZACHEM, SECRETARY

Florida dbpr

**STATE OF FLORIDA**
**DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION**

**ASBESTOS LICENSING UNIT**

THE ASBESTOS CONSULTANT HEREIN IS LICENSED UNDER THE PROVISIONS OF CHAPTER 469, FLORIDA STATUTES

## HOLLEY, TOM C

TERRACON CONSULTANTS INC
5463 W WATERS AVE STE 830
C/O TERRACON CONSULTANTS
TAMPA FL 33634

**LICENSE NUMBER: AX75**
**EXPIRATION DATE: NOVEMBER 30, 2020**

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M·E·T·A
Mayhew Environmental Training Associates
INCORPORATED

Certificate # MEB1EB63D5B1B546E

## Pete MacKay

*has on 8/21/2019, in Tampa, FL*
*completed the requirements for asbestos accreditation under Section 206 of TSCA Title II, 15 USC 2646*

4-hr. Asbestos Building Inspector Refresher

*as approved by FL*
*and the US EPA under 40 CFR 763 (AHERA)*
*from 8/21/2019 to 8/21/2019 and passed the associated exam on 8/21/2019*
*with a score of at least 70%*

*Dean Althage*
*Instructor*

*Thomas Mayhew*
*President*

Training Provider #: FL49-0001221
Course #: 0004718
FL License #:
SSN: XXX-XX-4478
Expiration: 8/21/2020

P.O. Box 786 - Lawrence, KS. 66044 - 800.444.6382
www.metaenvironmental.net

# United States Environmental Protection Agency

## This is to certify that

Terracon Consultants Inc.

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint renovation, repair, and painting activities pursuant to 40 CFR Part 745.89

## In the Jurisdiction of:

All EPA Administered States, Tribes, and Territories

This certification is valid from the date of issuance and expires May 19, 2021

NAT-2606-2
Certification #

July 30, 2014
Issued On

Michelle Price, Chief
Lead, Heavy Metals, and Inorganics Branch

# United States Environmental Protection Agency

## This is to certify that

Peter C MacKay

has fulfilled the requirements of the Toxic Substances Control Act (TSCA) Section 402, and has received certification to conduct lead-based paint activities pursuant to 40 CFR Part 745.226 as:

Inspector

## In the Jurisdiction of:

All EPA Administered Lead-based Paint Activities Program States, Tribes and Territories

This certification is valid from the date of issuance and expires January 09, 2021

LBP-I-I182484-1
Certification #

December 26, 2017
Issued On

Adrienne Priselac, Manager, Toxics Office
Land Division

# APPENDIX B

# CONSTRUCTION PLAN REVIEW PROVISO LETTERS

**Mission:**
To protect, promote & improve the health of all people in Florida through integrated state, county & community efforts.

Florida HEALTH

**Vision:** To be the Healthiest State in the Nation

**Ron DeSantis**
Governor

**Scott A. Rivkees, MD**
State Surgeon General

CONSTRUCTION PLAN REVIEW
PROVISO LETTER

**Facility:** **NEW 52/XXXXXXX**
**Pinellas Cnty-St. Petersburg-Clearwater Intl Airport Vault**
**14700 Terminal Blvd**
**Clearwater**
**PINELLAS**

The Florida Department of Health in Pinellas County (DOH-Pinellas) has been authorized by contract with the Florida Department of Environmental Protection (FDEP) to conduct Petroleum Storage Tank Compliance Program work in Pinellas County. On July 17, 2020, plans submitted by Steven Henriquez, AECOM, were reviewed for compliance with Chapter 62-762, Florida Administrative Code. The plans describe:

## INSTALLATION

Installation of one (1) 2000-gal diesel emergency generator aboveground storage tank (AST) and associated equipment, to include in part:

- Highland Tank Mfg 2000-gal double-wall steel UL-142 AST **(EQ-673)**
- Morrison Bros Fig 518 7.5-gallon spill containment **(EQ-345)**
- Guillotine Flow Restrictor overfill protection valve **(EQ–637)**
- Pneumercator LS600LD tank interstitial sensor **(EQ-589)**
- Pneumercator LS600 tank level sensor **(EQ-577)**
- Pneumercator LC1002 monitor alarm panel **(EQ-319)**
- Krueger tank level gauge **(EQ-730)**
- Manual ball valve & EBW anti-siphon valve to be installed on supply piping at tank outlet
- All supply & return piping to be aboveground ¾" Schedule 40 black iron

**NOTES:**

- Owner/Operator representative must provide notification in writing or electronic format between 30 and 45 days before the installation of the storage tank system.
- Chapter 62-521, F.A.C., contains restrictions regarding the location of storage tank systems within 500 feet of a potable water well.

The inspection coordinator is: **Randall Strauss** **randall.strauss@flhealth.gov** **727-275-6467**

**THE CONTRACTOR MUST PROVIDE A MINIMUM 48-HOUR NOTICE TO THE DESIGNATED INSPECTOR. FAILURE TO PROVIDE THIS NOTICE MAY RESULT IN NO AGENCY INSPECTION.**

**The following must be inspected by this agency:**

- Observation of the tank delivery and setting in final installation location
- Observation of the integrity testing of the AST in accordance with manufacturer's instructions following the setting of the tank
- Observation of air pressure/soap testing of product piping
- Observation of a hydrostatic test of the spill containment unit
- Observation of the proper installation and operation of overfill protection devices – overfill alarm devices must be set to alarm at or below 90% tank capacity, and overfill shut-off devices must be set to close at or below 95% tank capacity
- Observation and verification of the operability of release detection devices (interstitial sensor)
- Observation of the marking of the fill covers in accordance with API 1637

A final inspection will be performed upon completion of all construction to include:

- Demonstration that the new tank system has the appropriate 3rd Party Petroleum Liability & Corrective Action coverage
- Current tank registration placard is posted at the facility

I, Steve Henriquez, acting as a representative of AECOM have reviewed this document with the DOH-Pinellas, Petroleum Storage Tank Compliance Program staff, and am aware of the specified conditions and notification timeframes.

AECOM 7/27/20 Date

**Reviewed by:**

Randall H. Strauss
FDOH-Pinellas County
Petroleum Storage Tank Compliance

Date: July 24, 2020

CONSTRUCTION PLAN REVIEW
PROVISO LETTER

**Facility:** **52/8515556**
**St Petersburg-Clearwater Intl Aprt-Terminal Bldg #221**
**15707 Fairchild Dr**
**Clearwater**
**PINELLAS**

The Florida Department of Health in Pinellas County (DOH-Pinellas) has been authorized by contract with the Florida Department of Environmental Protection (FDEP) to conduct Petroleum Storage Tank Compliance Program work in Pinellas County. On July 17, 2020, plans submitted by Steven Henriquez, AECOM, were reviewed for compliance with Chapter 62-762, Florida Administrative Code. The plans describe:

## CLOSURE

Closure of one (1) 1000-gal diesel emergency generator aboveground storage tank (AST) and associated piping & equipment by removal from the site:

- Highland Tank Mfg 1000-gal double-wall steel vertical UL-142 AST
- Supply & return product piping to adjacent generator

**NOTES:**

- Owner/Operator representative must provide notification in writing or electronic format between 30 and 45 days before the closure of the storage tank system.
- The inspection coordinator is to be determined. The Pinellas Storage Tank Compliance Program Office should be contacted at **727-538-7277** 30 days prior to the closure to determine the designated inspector.

**THE CONTRACTOR MUST PROVIDE A MINIMUM 48-HOUR NOTICE TO THE DESIGNATED INSPECTOR. FAILURE TO PROVIDE THIS NOTICE MAY RESULT IN NO AGENCY INSPECTION.**

**The following must be inspected by this agency:**

- Observation the tank has been emptied and properly cleaned before removal from site
- Observation of the tank loading and removal from the site

**The following items are required to be submitted to complete the closure documentation:**

- The DEP Storage Tank registration for Facility ID #8515556 must be updated within 10 days of the completion of the closure to report DEP Tank ID #12, 1000-gal emergency generator diesel tank installed in November 2009, has been closed by removal from the site. The registration update can be submitted to DEP with a completed Storage Tank Facility Registration Form emailed to tankregistration@floridadep.gov or entered in the DEP's on-line registration portal: https://floridadep.gov/waste/permitting-compliance-assistance/content/storage-tank-facility-registration
- A DEP "Limited Closure Report Form for ASTs" must be submitted to the local Pinellas County Storage Tank Program office or inspector within 60 days of the completion of the closure. The report should include a tank-cleaning waste disposal manifest and documentation of the final disposition of the tank, i.e, sold, scrapped-out or relocated for possible re-use.

I, Steve Henriquez, acting as a representative of AECOM have reviewed this document with the DOH-Pinellas, Petroleum Storage Tank Compliance Program staff, and am aware of the specified conditions and notification timeframes.

AECOM 7/27/20 Date

**Reviewed by:**

Randall H. Strauss
FDOH-Pinellas County
Petroleum Storage Tank Compliance

Date: July 27, 2020

# APPENDIX C

# AS-BUILT DRAWINGS ON OLD ELECTRICAL VAULT SITE

Michael Baker
INTERNATIONAL

# Submittal Transmittal Form

| St. Pete – Clearwater International Airport Ticketing "A" BHS | **Baker Project** # 155631 |
|---|---|

| **Transmitted To:** | **Transmitted By:** |
|---|---|
| Jason Axtell<br>Manhattan Construction Company<br>5840 W. Cypress Street, Suite A<br>Tampa, Florida 33607<br>Tel: 813-675-1990<br>Cell: 316-990-5266<br>JAxtell@manhattanconstruction.com | Chip Hayward, AIA, CSI-CCCA, LEED GA<br>Michael Baker International<br>5020 West Linebaugh Avenue, Suite 240<br>Tampa, Florida 33624<br>Tel: (813) 889-3892<br>Fax: (813) 889-3893<br>chayward@mbakerintl.com |

| Qty. | Submittal No./Date | Description | Pages Reviewed |
|---|---|---|---|
| 1 | 02000-4.1<br>08/27/2020 | Final Civil As-Builts | 6 |

| **Transmitted For:** | **Transmitted Via:** |
|---|---|
| Review and Responses or Action Noted | |

☒ No Exceptions
☐ Exception Noted
Submit ____ Corrected Copies
☐ Revise and Resubmit
☐ Rejected

This Review is only for conformance with the design concept of the Project and compliance with the information given in the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site; for information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; and for coordination of the work of all trades. Approval of a specific item does not indicate approval of an assembly of which the item is a component. Approval of items does not relieve the contractor from complying with all requirements of the Contract Documents.

**A/E Review Comments:**

Signature
Nathan Parish, PE

08/27/2020

Date

| **Cc: Company Name** | **Contact Name** |
|---|---|
| St. Pete-Clearwater Airport | Scott Yarley, PE |
| AID | Michael Cummings |
| Michael Baker Intl. | |
| File | |

# CONSTRUCTION DOCUMENTS

FOR

# TERMINAL AREA IMPROVEMENTS

# TICKETING "A" BAGGAGE CLAIM SYSTEM

## ST. PETE-CLEARWATER INTERNATIONAL AIRPORT

AT

**PINELLAS COUNTY, FLORIDA**

**PINELLAS COUNTY BID NO. TBD**

## AS-BUILT DRAWINGS

### *SURVEYOR'S REPORT*

**TYPE OF SURVEY:**

AS-BUILT SURVEY
FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

**MAP OF SURVEY:**

THE MAP AND REPORT ARE NOT FULL AND COMPLETE WITHOUT THE OTHER.
SEE MAP OF SURVEY SHEET 01 OF 05 THRU SHEET 05 OF 05.

**LEGAL DESCRIPTION:**

NOT APPLICABLE. THIS IS NOT A BOUNDARY SURVEY.

**ACCURACY:**

1. ALL MEASUREMENTS, DISTANCES, ELEVATIONS AND FEATURES WERE PERFORMED IN STRICT ACCORDANCE WITH THE STANDARDS OF PRACTICE SET FORTH IN CHAPTER 5J-17 OF THE FLORIDA ADMINISTRATIVE CODE.

2. METHODS FOR ALL CONTROL MEASUREMENTS WERE MADE WITH A TRANSIT AND STEEL TAPE, OR DEVICES WITH EQUIVALENT OR HIGHER DEGREES OF ACCURACY.

3. THE ACCURACY STANDARD USED FOR THIS SURVEY, AS CLASSIFIED IN THE STANDARDS OF PRACTICE 5J-17 F.A.C., IS "COMMERCIAL HIGH RISK". THE MINIMUM RELATIVE DISTANCE ACCURACY FOR THIS TYPE OF SURVEY IS 1 FOOT IN 10,000 FEET. THIS SURVEY IS BASED ON REPETITIVE RTK GPS AND/OR ROBOTIC TOTAL STATION OBSERVATIONS ON MULTIPLE PROJECT HORIZONTAL AND VERTICAL CONTROL POINTS TO OBTAIN A REDUNDANCY OF MEASUREMENT. HORIZONTAL AND VERTICAL CLOSURE ACHIEVED, EXCEED THE MINIMUM ACCURACY REQUIREMENTS FOR THIS SURVEY.

**DATA SOURCES:**

1. CONSTRUCTION PLANS "TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM" PREPARED BY MICHAEL BAKER INTERNATIONAL, TEL: (813) 889-3892, PROJECT NO. 155631, DATED MARCH 30, 2018 WAS UTILIZED IN THE PREPARATION OF THIS SURVEY.

2. FIRELINE AS-BUILT SURVEY BY ACCURATE SURVEYING OF FLORIDA, TEL (724) 420-0999, DATED APRIL 29, 2020 WAS UTILIZED IN THE PREPARATION OF THIS SURVEY.

3. COORDINATES SHOWN HERE ON ARE IN FEET AND REFERENCED TO FLORIDA STATE PLANE COORDINATE SYSTEM, WEST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD83) - 2007 ADJUSTMENT. (DATA SOURCES #1)

4. ELEVATIONS SHOWN HERE ON ARE IN FEET AND REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88). PARENT BENCHMARK: NATIONAL GEODETIC SURVEY BENCHMARK, PID AG0646, DESIGNATION "JORDAN E", ELEVATION = 6.27 FEET. (DATA SOURCES #1).

5. ON SITE HORIZONTAL/VERTICAL CONTROL POINTS USED FOR THIS SURVEY: CONTROL POINT 21, SET RIVET AND DISK, "FERGUSON LB 8128", NORTHING 1299163.17 FEET, EASTING 433093.88 FEET, ELEVATION = 10.17 FEET AND CONTROL POINT 18, SET RIVET AND DISK, "FERGUSON LB 8128", NORTHING 1299124.23 FEET, EASTING 433217.73 FEET, ELEVATION = 9.90 FEET, AND THE LINE BETWEEN SAID CONTROL POINTS 21 & 18 BEING THE BASIS OF BEARING S72°32'46"E, AS SHOWN ON THE MAP OF SURVEY.

**LIMITATIONS:**

1. PURPOSE OF SURVEY: TO OBTAIN HORIZONTAL AND VERTICAL DIMENSIONAL DATA SO THAT CONSTRUCTED IMPROVEMENTS MAY BE LOCATED AND DELINEATED.

2. NON-VISIBLE, SUBSURFACE AS-BUILT PIPE LOCATIONS AND TOP OF PIPE ELEVATIONS WERE PROVIDED BY THE CONTRACTOR (DENOTED WITH * ASTERISK). FLS ASSUMES NO LIABILITY AS TO THE ACCURACY OF THE SUBSURFACE LOCATIONS PROVIDED BY THE CONTRACTOR, OTHER THAN THE AS-BUILT DATA PROVIDED WAS CORRECTLY CALCULATED, PLOTTED AND SHOWN ON THE MAP OF SURVEY. (DATA SOURCE 2)

3. THE SCREENED INFORMATION SHOWN ON THE MAP OF SURVEY IS PER PLAN (DATA SOURCES 1) AND FOR COMPARISON PURPOSES ONLY AND IS NOT A PART OF THE AS-BUILT INFORMATION. THE **BOLD DARK PRINT AND LINE WORK** IS AS-BUILT INFORMATION OBTAINED AND PROVIDED BY FERGUSON LAND SURVEYORS.

4. LAST FIELD DATE OF SURVEY: 04/16/2020, AS REFERENCED IN FIELD BOOK 559, PAGE 21-27.

5. THIS IS NOT A BOUNDARY OR RIGHT-OF-WAY SURVEY.

6. PRINTED DIMENSIONS SHOWN ON THE SURVEY SUPERSEDE SCALED DIMENSIONS. THERE MAY BE ITEMS DRAWN OUT OF SCALE TO GRAPHICALLY SHOW THEIR LOCATION.

7. USE OF THIS SURVEY BY ANYONE OTHER THAN THOSE PREPARED FOR OR CERTIFIED TO, WILL BE THE RE-USERS SOLE RISK WITHOUT LIABILITY TO THE SURVEYOR.

8. SHOWN ANYWHERE ON THIS SURVEY, THE WORD "CERTIFY" IS UNDERSTOOD TO BE AN EXPRESSION OF A PROFESSIONAL OPINION BASED UPON THE SURVEYOR'S BEST KNOWLEDGE, INFORMATION AND BELIEF, AND THAT IT CONSTITUTES NEITHER A GUARANTEE NOR A WARRANTY.

**BOUNDARY INCONSISTENCIES:**

NOT APPLICABLE.

**EASEMENTS/RIGHT-OF-WAY:**

NOT APPLICABLE.

**PREPARED FOR AND CERTIFIED TO:**

MANHATTAN CONSTRUCTION COMPANY
1715 N. WESTSHORE BLVD - SUITE 175
TAMPA, FLORIDA 33607
TEL: (813) 675-1987

**SURVEYOR AND MAPPER IN RESPONSIBLE CHARGE:**

TERRY D. FERGUSON
PROFESSIONAL SURVEYOR AND MAPPER
LICENSE NUMBER LS 4535
STATE OF FLORIDA
TEL: (727) 230-9606

pie St. Pete-Clearwater International

TAMPA BAY THE EASY WAY

| INDEX OF DRAWINGS | |
|---|---|
| DWG. NO. | SHEET TITLE |
| C0.00 | COVER SHEET AND INDEX |
| C0.01 THRU C0.02 | CIVIL GENERAL NOTES |
| C1.00 | PROJECT PHASING AND SAFETY PLAN |
| C1.01 | SURVEY CONTROL PLAN |
| C1.02 | DEMOLITION PLAN |
| C2.00 | SITE PLAN |
| C2.01 THRU C2.03 | CIVIL SITE DETAILS |
| C3.00 | GRADING AND DRAINAGE PLAN |
| C3.01 | GRADING AND DRAINAGE DETAILS |
| C4.00 | JOINT LAYOUT PLAN |
| C4.01 | JOINT ELEVATION PLAN |
| C4.02 | JOINT DETAILS |
| C5.00 | UTILITY PLAN |
| C5.01 | DRAINAGE AND WATER PROFILE |
| C5.02 THRU C5.04 | UTILITY DETAILS |
| C6.00 | SIGNING AND MARKING PLAN |
| C7.00 | CART PATH PLAN |

## ISSUED FOR CONSTRUCTION - MARCH 30, 2018


Michael Baker
INTERNATIONAL
**MICHAEL BAKER INTERNATIONAL**
5020 WEST LINEBAUGH AVE., SUITE 240 • TAMPA, FL 33624
PHONE 813-889-3892 • FAX 813-889-3893
NATHAN E. PARISH, FL PE LICENSE NO. 68317
MICHAEL BAKER INTERNATIONAL FLORIDA CERTIFICATE OF AUTHORIZATION NO. 28861

BAKER PROJECT NO. #155631

AS-BUILT SURVEY FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

THE MAP AND REPORT ARE NOT FULL AND COMPLETE WITHOUT THE OTHER.
SEE SHEET (1) FOR SURVEYOR'S REPORT AND CERTIFICATIONS.

| | | |
|---|---|---|
| FLS PN: 18012-A1 | Ferguson Land Surveyors | PROJECT MGR: TDF |
| FB 559, PG 21-27 | | DRAWN BY: SJD |
| FIELD DATE: 04/16/20 | | SHEET 01 OF 05 |

806 FRANKLIN STREET, CLEARWATER, FL 33756 - PH. 727.230.9606 FAX 727.230.9234 - LB No.: 8128

THIS MAPPING CONFORMS TO STANDARDS OF PRACTICE FOR AN AS-BUILT SURVEY AS SET FORTH BY THE FLORIDA BOARD OF PROFESSIONAL SURVEYORS AND MAPPERS IN CHAPTER 5J-17 PURSUANT TO SECTION 427.027 FLORIDA STATUTES.

NOT VALID WITHOUT THE SIGNATURE AND THE ORIGINAL RAISED SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPERS. ADDITIONS OR DELETIONS TO SURVEY MAPS BY ANYONE OTHER THAN THE SIGNING SURVEYORS IS PROHIBITED WITHOUT WRITTEN CONSENT OF THE SIGNING SURVEYOR.

**PRELIMINARY**

TERRY D. FERGUSON, P.S.M.
FLORIDA SURVEYORS REGISTRATION LS NO. 4535

## LEGEND

- NEW CONC. PAVEMENT, TYPE 1
- NEW CONC. PAVEMENT, TYPE 2
- NEW ASPHALT PAVEMENT
- ASPHALT PAVEMENT TRANSITION SEE SHEET C2.01 FOR DETAIL
- NEW CONC. SIDEWALK
- PROJECT LIMITS
- VAPOR BARRIER LIMITS

E ROADWAY AND PARKING
/EMENTS

SEE GRADING AND DRAINAGE AND ARCHITECT DRAWINGS

APPLY TERMITE TREATMENT AND VAPOR BARRIER PRIOR TO CONSTRUCTING CONCRETE, SEE SPECIFICATIONS 07260 & 02361

PROPOSED CANOPY COLUMN FOUNDATION SEE STRUCTURAL DRAWINGS (TYPICAL)

INSTALL BOLLARD (SEE ARCHITECTURAL DRAWINGS)(TYPICAL)

TERMINAL FF EL: 12.67

N: 1299229.3240
E: 433200.7870
CORNER OF EXIST. SLAB ON JOINT

N: 1299234.4400
E: 433206.1380
CORNER OF EXIST. SLAB ON JOINT

N: 1299235.6293
E: 433215.0586
CORNER OF SLAB ON JOINT

N: 1299223.4430
E: 433216.7570

N: 1299223.0250
E: 433213.7970
CORNER OF EXIST. SLAB ON JOINT

BUILDING CORNER
TIE TO EXISTING
N: 1299230.20'
E: 433202.40'

N: 1299206.6256
E: 433064.5468

5.00'

INSTALL NEW SECURED CHAIN LINK FENCE W/ INTEGRAL SLATS SEE FENCE DETAIL

BUILDING CORNER
TIE TO EXISTING
N: 1299209.38'
E: 433085.06'

EXIST. ELECT./COMM. BOX TO BE PROCTED/ADJUSTED. SEE UTILITY PLAN

INSTALL BOLLARD (SEE ARCHITECTURAL DRAWINGS)(TYPICAL)

TERMINAL WALL EXTENSION (SEE ARCHITECTURAL DRAWINGS)

BUILDING CORNER
N: 1299186.16'
E: 433208.75'

2.50'

10.28'

TERMINAL WALL EXTENSION (SEE ARCHITECTURAL DRAWINGS)

INSTALL GALVANIZED BOLLARD RAILS (REFER TO ARCHITECTURAL DRAWINGS)

BUILDING CORNER
N: 1299169.73'
E: 433090.76'

CANOPY OVERHANG LIMITS

INSTALL NEW BOLLARDS (REFER TO ARCHITECTURAL DRAWINGS FOR DETAIL)

VAULT BLDG FF EL: 10.20

CONTROL POINT 21
SET RIVET & DISK
"FERGUSON LB 8128"
N: 1299163.17
E: 433093.88
EL: 10.17

ELECTRICAL VAULT BUILDING

NEW HIGH MAST LIGHT LOCATION SHOWN IS APPROXIMATE. COORDINATE FINAL LOCATION WITH AIRPORT AND UNDERGROUND UTILITIES. SEE UTILITY PLAN FOR ADDITIONAL INFORMATION

SERVICE TRUCK PARKING POSITION. NO MARKINGS PROPOSED.

INSTALL RELOCATED BIKE RACK

N: 1299149.6127
E: 433072.5525

N: 1299141.8133
E: 433021.1772

N: 1299140.9310
E: 433015.2318

N: 1299129.8058
E: 433075.3340

BASIS OF BEARINGS
S 72°32'46" E 129.82'

N: 1299145.9910
E: 433224.6290

CONTROL POINT 18
SET RIVET & DISK
"FERGUSON LB 8128"
N: 1299124.23
E: 433217.73
EL: 9.90

20.00'

2.00'
TIE-IN
SEE SHEET C2.01

N: 1299122.0271
E: 433024.1006

EXISTING CONCRETE PAD TO REMAIN

CONNECT TO EXISTING CHAIN LINK FENCE

N: 1299134.0401
E: 433123.0734
ON FENCE

CONSTRUCT GRAVEL PIT (SEE SHEET C3.01 FOR DETAIL)

N: 1299119.9330
E: 433003.6470

INSTALL NEW NON-SECURED CHAIN LINK FENCE SEE FENCE DETAIL

6.00'

N: 1299126.8046
E: 433073.2759
NEW FENCE CORNER

N: 1299127.1572
E: 433075.7066

N: 1299131.3587
E: 433123.4037

PROTECT EXIST. TRANSFORMER AND PAD

CONTRACTOR SHALL PROVIDE UNOBSTRUCTED ACCESS TO HYDRANT DURING ALL PHASES OF CONSTRUCTION

N: 1299116.6794
E: 433003.6004

N: 1299118.8351
E: 433018.4424

2.00'
(TYP)

INSTALL PERFORMANCE TURF (FDOT 570)

TERMINAL BLVD.

N: 1299098.1208
E: 433027.6453

EXISTING PARKING AREA

INSTALL PRE-CAST CONCRETE WHEEL STOPS (TYP) SECTION 02740

INSTALL NEW SECURED CHAIN LINK FENCE W/ INTEGRAL SLATS SEE FENCE DETAIL

N: 1299093.3830
E: 433001.7170
FENCE POST

N: 1299093.8565
E: 433022.2738

N: 1299097.2432
E: 433021.7098

CONTROL PT #102
SET NAIL AND DISK
ELEV=10.39

METAL STAIRS

### AS-BUILT LEGEND

| | |
|---|---|
| N | NORTHING |
| E | EASTING |
| EL | ELEVATION |
| FF | FINISHED FLOOR |
| TYP | TYPICAL |
| INV | INVERT |
| FDC | FIRE DEPARTMENT CONNECTION |
| PVC | POLYVINYL CHLORIDE |
| DIP | DUCTILE IRON PIPE |
| RCP | REINFORCED CONCRETE PIPE |
| CONC | CONCRETE |
| ELEC | ELECTRIC |
| EPB | ELECTRIC PULLBOX |
| T.O.N. | TOP OF NUT |

**PRELIMINARY**

AS-BUILT SURVEY FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

THE MAP AND REPORT ARE NOT FULL AND COMPLETE WITHOUT THE OTHER.
SEE SHEET (1) FOR SURVEYOR'S REPORT AND CERTIFICATIONS.

| | | |
|---|---|---|
| FLS PN: 18012-A1 | Ferguson Land Surveyors | PROJECT MGR: TDF |
| FB 559, PG 21-27 | | DRAWN BY: SJD |
| FIELD DATE: 04/16/20 | | SHEET 02 OF 05 |

806 FRANKLIN STREET, CLEARWATER, FL 33756 - PH. 727.230.9606 FAX 727.230.9234 - LB No.: 8128

N W E S

0 10 20 40
SCALE IN FEET

AS-BUILT DRAWINGS

St. Pete-Clearwater International
TAMPA BAY THE EASY WAY

ST. PETE - CLEARWATER
INTERNATIONAL AIRPORT


Michael Baker
INTERNATIONAL
MICHAEL BAKER INTERNATIONAL,INC
5020 WEST LINEBAUGH AVE., SUITE 240
TAMPA, FL 33624
PHONE 813-889-3892 • FAX 813-889-3893
CERTIFICATE OF AUTHORIZATION NUMBER 28861


NATHAN EDWARD PARISH
LICENSE
No. 68317
STATE OF
FLORIDA
PROFESSIONAL ENGINEER
ENGINEER OF RECORD
NATHAN E. PARISH
FL PE LICENSE NO. 68317

Key Plan:

**ISSUED FOR CONSTRUCTION**
**MARCH 30, 2018**
★ ★ ★ ★ ★

REVISIONS

| No. | Description | Date | By |
|---|---|---|---|
| 1 | ADDENDUM 3 | 11/08/2017 | SMR |

| Designed by: | Drawn by: | Checked by: |
|---|---|---|
| JS | BB | JS |

Project Name:
**PHASE IV**
**TERMINAL AREA IMPROVEMENTS**
**TICKETING "A" BAGGAGE CLAIM**

Drawing Name:
**SITE PLAN**

| Project Number: | Division : |
|---|---|
| #155631 | CIVIL |

Date: MARCH 30, 2018

Drawing Number:
**C2.00**

## LEGEND

- 395 — EXISTING CONTOUR
- 395 — PROPOSED CONTOUR
- IP — INLET PROTECTION
- PROJECT LIMITS
- NEW PCC PAVEMENT, TYPE 1
- NEW CONCRETE PAVEMENT, TYPE 2
- NEW CONC. SIDEWALK
- ASPHALT PAVEMENT TIE IN SEE DETAIL ON SHEET C2.01
- ARGENTINE BAHIA SOD, FDOT 570
- GRAVEL ENVELOPE, SEE SHEET C3.01

NOTES
1. ALL NEW ROOF DRAIN PIPING SHALL BE 8-INCH SCHEDULE 40 PVC. A MIN. COVER DEPTH OF 24" SHALL BE PROVIDED AND A MIN. SLOPE OF .50% FOR ALL UNDERGROUND ROOF DRAIN PIPING.
2. SEE PLUMBING PLANS FOR ROOF DRAIN CONNECTION AND ABOVE-GRADE CLEAN-OUT DETAILS.
3. A SLEEVE WILL BE REQUIRED THROUGH FOOTINGS FOR ROOF DRAIN DOWNSPOUTS , SEE PLUMBING AND STRUCTURAL PLANS FOR DETAILS.
4. PROPOSED "CORRUGATED PVC" PIPE SHALL BE A2000 AS MANUFACTURED BY CONTECH OR APPROVED EQUAL. SEE REVISED SPECIFICATION 02998

EXISTING TERMINAL ENTRANCE ROAD

CONTRACTOR SHALL CONNECT PROPOSED 18" RCP TO EXIST. MANHOLE

NEW 3X3 POLYMER CONCRETE CATCH BASIN AS MANUFACTURED BY ACO OR APPROVED EQUIVALENT. SIZE SIDE PIPE OPENING TO ACCOMODATE SCH. 40 12" PVC PIPE.

CONTRACTOR TO FORM AND CAST CONCRETE STRUCTURE IN-PLACE.

TIE TO PROPOSED DOWNSPOUT (SEE PLUMBING PLANS)

CONNECT TO HUB DRAIN AND CONDENSATE DRAIN. SEE PLUMBING

INSTALL ROOF DRAIN 8" SCHEDULE 40 PVC TO NEARES DOWNS

CONNECT ROOF DOWN DRAIN TO PROPOSED STRUCTURE S6

EXISTING TERMINAL BUILDING TERMINAL FF EL: 12.67

CONC LANDING W/ HANDRAIL

CONC RAMP W/ HANDRAIL

6" PVC CLEANOUT TOP EL: 12.60

6" PVC CLEANOUT TOP EL: 12.44

TYP. (TYPICAL), SEE NOTE 1

18" CORRUG EXISTING BUILING

BLOCK WALL

FDC

RIM EL: 11.36
N INV EL: 5.21(18" RCP)
E INV EL: 5.21(18" RCP)

RIM EL: 10.09
N INV EL: 5.79(8" PVC)
E INV EL: 3.69(18" A2000)
S INV EL: 5.29(8" PVC)
W INV EL: 5.27(18" A2000)

ELEC VAULT TOP EL: 10.19
BOTTOM EL: 4.19
DUCT BANKS TOP EL: 6.69
N, S, E, W

RIM EL: 9.54
S INV EL: 4.10(15" RCP)
S INV EL: 3.60(8" PVC)
E INV EL: 5.64(12" A2000)
W INV EL: 5.44(18" A2000)

18" CORRUGATED PVC

PAINTED DASHED LINE (TYP)

AIRCRAFT APRON

RIM EL: 10.09
S INV EL: 5.99(12" A2000)
N INV EL: 7.99(4" A2000)
W INV EL: 7.12(8" PVC)

CORRUGATED PVC

RIM EL: 9.97
N INV EL: 5.87(12" A2000)
W INV EL: 5.87(12" A2000)
E INV EL: 7.86(4" A2000)

PROPOSED ROOF DOWNSPOUT TYP. (SEE ARCHITECTURAL DRAWINGS)(TYP)

PROPOSED ROOF DOWNSPOUT TYP. (SEE PLUMBING PLANS)

T.O.N. EL: 8.96

ADJUST MONITORING WELLS TO FINISH GRADE

VAULT BLDG FF EL: 10.20

ELEC VAULT TOP EL: 10.15
BOTTOM EL: 6.15
DUCT BANKS TOP EL: 8.15 N,
6.95 N, 7.65 NW, 8.35 W, 7.35 E

ELEC VAULT TOP EL: 10.22
BOTTOM EL: 7.22
DUCT BANK TOP EL: 7.82
N, S, E, W

ELEC VAULT TOP EL: 10.18
BOTTOM EL: 3.93
DUCT BANKS TOP EL: 6.38 N,
8.38 S, 6.48 E, 8.18 W

ELECTRICAL VAULT BUILDING

RIM EL: 9.37
INV EL: 8.12(4" A2000)

BACKFLOW PREVENTER

4" PVC WITH CONCRETE COLLAR

PAINTED YIELD

GUARDRAIL (TYP)

CONC 10.28

HYD

INSTALL TEMPORARY FILTER SOCKS ALONG FENC

TRANSFORMER

5'X7" METAL BOLLARD (TYP)

INSTALL BOLLARD (SEE ARCHITECTURAL DRAWINGS)(TYP)

EPB
PANEL
ELEC

6" WHITE PAINTED LINE (TYP)

PAINTED ARROW (TYP)

PAINTED SPEED LIMIT (TYP)

S7

RIM EL: 9.54
N INV EL: 5.29(15" RCP)
S INV EL: 5.29(15" RCP)
E INV EL: 7.86(4" A2000)

45 DEG PVC ELBOW

INSTALL 4-INCH NON-PERFORATED UNDERDRAIN AND TIE TO PROPOSED INLET

EXISTING PARKING AREA

6' CHAIN LINK FENCE

CONC WHEEL STOP (TYP)

BIKE RACK NEW LOCATION

TERMINAL BLVD.

S1 S2 S3 S4 S5 S6

### AS-BUILT LEGEND

| | |
|---|---|
| N | NORTHING |
| E | EASTING |
| EL | ELEVATION |
| FF | FINISHED FLOOR |
| TYP | TYPICAL |
| INV | INVERT |
| FDC | FIRE DEPARTMENT CONNECTION |
| PVC | POLYVINYL CHLORIDE |
| DIP | DUCTILE IRON PIPE |
| RCP | REINFORCED CONCRETE PIPE |
| CONC | CONCRETE |
| ELEC | ELECTRIC |
| EPB | ELECTRIC PULLBOX |
| T.O.N. | TOP OF NUT |

**PRELIMINARY**

AS-BUILT SURVEY FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

THE MAP AND REPORT ARE NOT FULL AND COMPLETE WITHOUT THE OTHER. SEE SHEET (1) FOR SURVEYOR'S REPORT AND CERTIFICATIONS.

| | | |
|---|---|---|
| FLS PN: 18012-A1 | Ferguson Land Surveyors | PROJECT MGR: TDF |
| FB 559, PG 21-27 | | DRAWN BY: SJD |
| FIELD DATE: 04/16/20 | | SHEET 03 OF 05 |

806 FRANKLIN STREET, CLEARWATER, FL 33756 - PH. 727.230.9606 FAX 727.230.9234 - LB No.: 8128

N W E S

0 10 20 40
SCALE IN FEET

AS-BUILT DRAWINGS

St. Pete-Clearwater International
TAMPA BAY THE EASY WAY

ST. PETE - CLEARWATER INTERNATIONAL AIRPORT


Michael Baker INTERNATIONAL
MICHAEL BAKER INTERNATIONAL,INC
5020 WEST LINEBAUGH AVE., SUITE 240
TAMPA, FL 33624
PHONE 813-889-3892 • FAX 813-889-3893
CERTIFICATE OF AUTHORIZATION NUMBER 28861


NATHAN EDWARD PARISH LICENSE No. 68317 STATE OF FLORIDA PROFESSIONAL ENGINEER
NATHAN E. PARISH
FL PE LICENSE NO. 68317

Key Plan:

ISSUED FOR CONSTRUCTION
MARCH 30, 2018

REVISIONS

| No. | Description | Date | By |
|---|---|---|---|
| 1 | ADDENDUM 3 | 11/08/2017 | SMR |

| Designed by: | Drawn by: | Checked by: |
|---|---|---|
| JS | BB | JS |

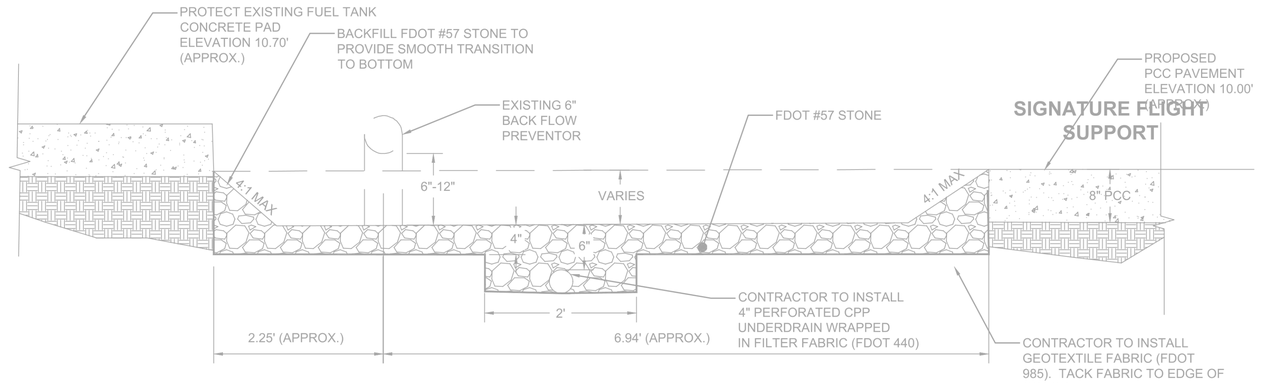
Project Name:
PHASE IV
TERMINAL AREA IMPROVEMENTS
TICKETING "A" BAGGAGE CLAIM

Drawing Name:
GRADING AND DRAINAGE PLAN

| Project Number: | Division : |
|---|---|
| #155631 | CIVIL |

Date: MARCH 30, 2018

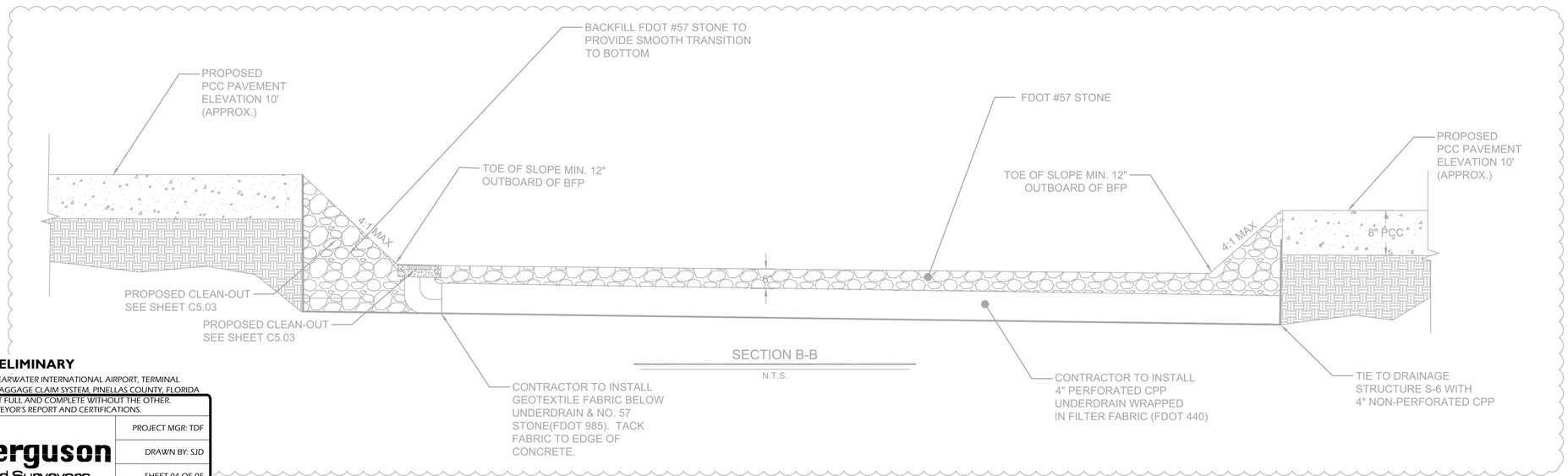
Drawing Number:
C3.00




SECTION A-A

N.T.S.

1




SECTION B-B

N.T.S.

1

**PRELIMINARY**

AS-BUILT SURVEY FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

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NO AS-BUILTS THIS SHEET

**AS-BUILT DRAWINGS**


St. Pete-Clearwater International
TAMPA BAY THE EASY WAY

ST. PETE - CLEARWATER INTERNATIONAL AIRPORT

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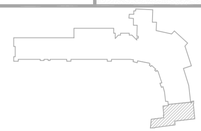
FL PE LICENSE NO. 68317

Key Plan:



**ISSUED FOR CONSTRUCTION**
**MARCH 30, 2018**

★ ★ ★ ★ ★

REVISIONS

| No. | Description | Date | By |
|---|---|---|---|
| 1 | ADDENDUM 3 | 11/08/2017 | SMR |

| Designed by: | Drawn by: | Checked by: |
|---|---|---|
| JS | BB | JS |

Project Name:

**PHASE IV**
**TERMINAL AREA IMPROVEMENTS**
**TICKETING "A" BAGGAGE CLAIM**

Drawing Name:

# GRADING AND DRAINAGE DETAILS

| Project Number: | Division : |
|---|---|
| #155631 | CIVIL |

Date: MARCH 30, 2018

Drawing Number:

# C3.01

## UTILITY NOTES

1. WATER MAIN SHALL BE ADJUSTED BELOW STORM PIPE AND OTHER UTILITIES AS REQUIRED.
2. EXISTING COMMUNICATION LINES SHALL BE SURROUNDED WITH A SCHEDULE 40 PVC SPLIT DUCT CONDUIT AND PROTECTED DURING CONSTRUCTION. (SEE NOTE I)
3. EXISTING ELECTRICAL SHALL HAVE A SCHEDULE 40 PVC SPLIT DUCT CONDUIT INSTALLED AND PROTECTED DURING CONSTRUCTION. (SEE NOTE I)
4. MAINTAIN AND PROTECT EXISTING FAA ELECTRICAL AND VAULT. EXISTING VAULT SHALL BE H-20 TRAFFIC RATED. MAINTAIN EXISTING CONCRETE ENCASEMENT. (SEE NOTE I)
5. MAINTAIN AND PROTECT EXISTING AIRFIELD ELECTRICAL AND VAULT. MAINTAIN EXISTING CONCRETE ENCASEMENT. (SEE NOTE I)
6. EXISTING FIRE HYDRANT SHALL BE ROTATED 180 DEGREES FROM WHERE IT SITS. (SEE NOTE I)
7. ALL NEW FIRE SUPPLY PIPE AND FDC'S SHALL BE PRESSURE TESTED

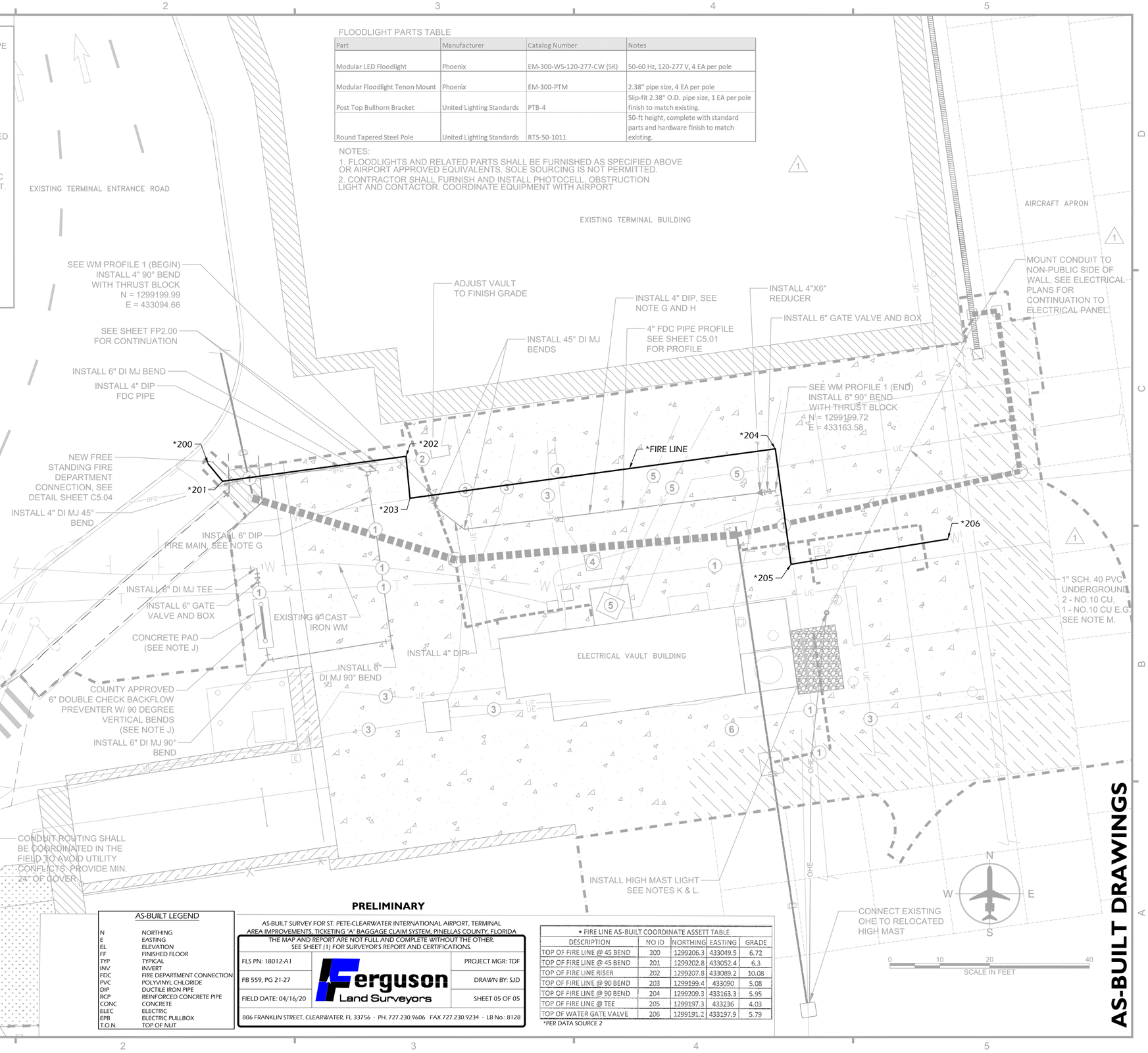
## NOTES

A. CONTRACTOR SHALL FIELD VERY ALL UTILITIES ABOVE AND UNDERGROUND AS WELL AS ALL VAULTS AND BOXES.
B. ALL COORDINATION OF CONSTRUCTION NEAR AN EXISTING UTILITY MUST BE COORDINATED WITH THE AIRPORT, ENGINEER AND PROPER UTILITY COMPANY BEFORE ANY ADJUSTMENT TO AN EXISTING UTILITY SHALL BE PERFORMED.
C. CONTRACTOR SHALL CONSTRUCT AROUND EXISTING UTILITIES UNLESS OTHERWISE NOTED ON THE PLANS.
D. CONTRACTOR MUST MAINTAIN THE SERVICE PROVIDED BY EACH UTILITY AT ALL TIMES. CONTRACTOR WILL BE FULLY RESPONSIBILE FOR ANY UTILITY SERVICE DAMAGED OR DISCONNECTED DURING CONSTRUCTION. THE EXPENSE TO REPAIR OR CONNECT DISCONNECTED SERVICE IS SOLELY AT THE CONTRACTOR'S EXPENSE.
E. ANY UTILITY THAT THE CONTRACTOR DEEMS NECESSARY TO ADJUST, RELOCATE, OR DISCONNECT NOT SHOWN ON THE PLANS MUST NOTIFY THE AIRPORT, ENGINEER, LOCAL UTILITY AND THE FAA PRIOR TO ANY WORK.
F. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATION AND GETTING THE PROPER PERMITS AND APPROVAL FOR ANY UTILITY ADJUSTMENT, RELOCATION OR DISCONNECTION.
G. INSTALL THRUST-BLOCK AND JOINT RESTRAINT ON NEW FDC AND FIRE MAIN PIPING PER PINELLAS COUNTY STANDARDS
H. FIELD VERIFY FDC AND FIRE MAIN SYSTEM OPERATION WITH AIRPORT PRIOR TO INSTALLATION.
I. FIELD ADJUST VERTICALLY AS REQUIRED IN COORDINATION W/ AIRPORT AND UTILITY OWNER.
J. DOUBLE CHECK VALVE ASSEMBLY BACKFLOW PREVENTER INSTALLED ON 3'x10'x6" THICK CONCRETE PAD. CONCRETE PAD AND THRUST RESTRAINT PER PINELLAS COUNTY STANDARDS.
K. A PHOTOMETRIC ANALYSIS & LIGHT AIMING IS TO BE SUBMITTED BY CONTRACTOR FOR REVIEW.
L. FURNISH AND INSTALL NEW POLE-MOUNTED LED FLOODLIGHTS. SEE LIGHT POLE FOUNDATION DETAIL SHEET 5.04 AND FLOODLIGHT PARTS TABLE, THIS SHEET.
M. CONDUIT ROUTING SHALL BE COORDINATED IN THE FIELD TO AVOID UTILITY CONFLICTS. PROVIDE MIN 24" OF COVER.

FLOODLIGHT PARTS TABLE

| Part | Manufacturer | Catalog Number | Notes |
|---|---|---|---|
| Modular LED Floodlight | Phoenix | EM-300-WS-120-277-CW (5K) | 50-60 Hz, 120-277 V, 4 EA per pole |
| Modular Floodlight Tenon Mount | Phoenix | EM-300-PTM | 2.38" pipe size, 4 EA per pole |
| Post Top Bullhorn Bracket | United Lighting Standards | PTB-4 | Slip-fit 2.38" O.D. pipe size, 1 EA per pole finish to match existing. |
| Round Tapered Steel Pole | United Lighting Standards | RTS-50-1011 | 50-ft height, complete with standard parts and hardware finish to match existing. |

NOTES:
1. FLOODLIGHTS AND RELATED PARTS SHALL BE FURNISHED AS SPECIFIED ABOVE OR AIRPORT APPROVED EQUIVALENTS. SOLE SOURCING IS NOT PERMITTED.
2. CONTRACTOR SHALL FURNISH AND INSTALL PHOTOCELL, OBSTRUCTION LIGHT AND CONTACTOR. COORDINATE EQUIPMENT WITH AIRPORT




**PRELIMINARY**

AS-BUILT LEGEND

| | |
|---|---|
| N | NORTHING |
| E | EASTING |
| EL | ELEVATION |
| FF | FINISHED FLOOR |
| TYP | TYPICAL |
| INV | INVERT |
| FDC | FIRE DEPARTMENT CONNECTION |
| PVC | POLYVINYL CHLORIDE |
| DIP | DUCTILE IRON PIPE |
| RCP | REINFORCED CONCRETE PIPE |
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| EPB | ELECTRIC PULLBOX |
| T.O.N. | TOP OF NUT |

AS-BUILT SURVEY FOR ST. PETE-CLEARWATER INTERNATIONAL AIRPORT, TERMINAL AREA IMPROVEMENTS, TICKETING "A" BAGGAGE CLAIM SYSTEM, PINELLAS COUNTY, FLORIDA

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* FIRE LINE AS-BUILT COORDINATE ASSETT TABLE

| DESCRIPTION | NO ID | NORTHING | EASTING | GRADE |
|---|---|---|---|---|
| TOP OF FIRE LINE @ 45 BEND | 200 | 1299206.3 | 433049.5 | 6.72 |
| TOP OF FIRE LINE @ 45 BEND | 201 | 1299202.8 | 433052.4 | 6.3 |
| TOP OF FIRE LINE RISER | 202 | 1299207.8 | 433089.2 | 10.08 |
| TOP OF FIRE LINE @ 90 BEND | 203 | 1299199.4 | 433090 | 5.08 |
| TOP OF FIRE LINE @ 90 BEND | 204 | 1299209.3 | 433163.3 | 5.95 |
| TOP OF FIRE LINE @ TEE | 205 | 1299197.3 | 433236 | 4.03 |
| TOP OF WATER GATE VALVE | 206 | 1299191.2 | 433197.9 | 5.79 |

*PER DATA SOURCE 2

AS-BUILT DRAWINGS

St. Pete-Clearwater International
TAMPA BAY THE EASY WAY

ST. PETE - CLEARWATER
INTERNATIONAL AIRPORT


Michael Baker
INTERNATIONAL
MICHAEL BAKER INTERNATIONAL,INC
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| 1 | ADDENDUM 3 | 11/08/2017 | SMR |

| Designed by: | Drawn by: | Checked by: |
|---|---|---|
| JS | BB | JS |

Project Name:
PHASE IV
TERMINAL AREA IMPROVEMENTS
TICKETING "A" BAGGAGE CLAIM

Drawing Name:
UTILITY PLAN

| Project Number: | Division : |
|---|---|
| #155631 | CIVIL |

Date: MARCH 30, 2018

Drawing Number:
C5.00

## Rice, Scott

**From:** Parish, Nathan
**Sent:** Thursday, August 27, 2020 2:05 PM
**To:** Rice, Scott
**Subject:** FW: EXTERNAL: You have 1 overdue Submittal

Scott – See below highlight.

**Nathan Parish, PE, CCM** | Project Manager - Aviation
4211 W Boy Scout Blvd. Suite 500 | Tampa, FL 33607 | [O] 813-466-6025 | [M] 813-355-1243
nathan.parish@mbakerintl.com | www.mbakerintl.com

Michael Baker INTERNATIONAL 80 YEARS Making a Difference

---

**From:** Tom Perry <TPerry@manhattanconstruction.com>
**Sent:** Thursday, August 27, 2020 3:03 PM
**To:** Michael Cummings <mcummings@aidinc.us>; Jason Axtell <JAxtell@manhattanconstruction.com>; Scott Yarley (syarley@fly2pie.com) <syarley@fly2pie.com>; Michael Miller <JMMiller@manhattanconstruction.com>
**Cc:** Parish, Nathan <Nathan.Parish@mbakerintl.com>; Hayward Jr., William A <CHayward@mbakerintl.com>
**Subject:** RE: EXTERNAL: You have 1 overdue Submittal

All,

I have received the revised civil as builts. I will be submitting via procore shortly.

The surveyor confirmed that the survey points were not affected during construction.

Thanks,

Tom

Manhattan
*Building excellence.*

**Tom Perry**
**Project Engineer**

Manhattan Construction Company
5840 W. Cypress St., Ste A,
Tampa, FL, 33607
813-675-1977 office
813-895-9040 cell

tperry@manhattanconstruction.com
www.manhattanconstruction.com
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