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BEAVERTON SCHOOL DISTRICT FIRE ALARM RESILIENCY – 8331 PROJECT GENERATOR / EMERGENCY

Beaverton, OR

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Work Covered by Contract Documents.
- C. Contract Method.
- D. Permits and Fees.
- E. Owner Occupancy.
- F. Contractor's Use of Site and Premise.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 WORK COVERED BY THE CONTRACT DOCUMENTS

- A. All work shall be performed on the Beaverton Schools.
- B. Work of this Contract, as more completely detailed in the Contract Documents consists of the brief descriptions below. The scope of work under this project includes, but is not limited to, the following elements:
 - 1. Provide emergency power extension as outlined on electrical drawings.
 - 2. Provide new emergency engine generators at schools outlined on electrical drawings.
 - 3. Provide outlined concrete work.
 - 4. Provide fencing and Architectural barriers.
 - 5. Wall replacement and patching.
- C. The Work shall include all supplies, tools, equipment, scaffolding, transportation, utilities, service, superintendence, labor, and the furnishing of all materials, items, and accessories needed for the Project.
- D. Contractor is to coordinate work to accommodate the continuous operation of the adjacent streets and utilities, without interruption or hindrance.
- E. The Contractor shall provide for all scheduling, coordination, cutting and patching and all other items required by the Contract Documents to complete the Work.

1.04 CONTRACT METHOD

- A. Construct the work under a Lump Sum Contract, furnished by the Owner.

1.05 PERMITS AND FEES

- A. The Contractor will provide all permits.

1.06 OWNER OCCUPANCY

- A. Owner Occupancy:
 - 1. The Owner will occupy the site and the existing building during the entire period of construction.
 - 2. Cooperate fully with the Owner or his representative during construction operations to minimize conflicts and to facilitate Owner usage.
- B. Scheduling Requirements:
 - 1. Contractor shall organize and coordinate work in a manner that does not interfere with the normal operations of areas of the facility being occupied and used by the Owner.
 - 2. Contractor shall maintain safe and convenient public access to the toilet rooms at all times that the facility is normally open to the public.
 - 3. Contractor shall continuously maintain public entry to the portions of the building being used by the Owner. The Contractor shall also continuously maintain safe, direct and legal

- exiting routes from all areas of the building to the outside.
4. Contractor may usually perform work in the building during evening hours. However, the Contractor shall be bound by the local, State and Federal regulations pertaining to such overtime work as required by the Contract Documents. Make necessary arrangements for such evening access with the Owner's Project Manager. Occasional activities may preclude Contractor's access on some evenings. Cooperate with the Owner so as not to interfere with the Owner's use of building areas being occupied by the public.

1.07 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Construction operations are to be limited to areas indicated on contractor's logistics plan approved by the Owner.
- B. Use of the Site:
 1. Do not encumber Site or facility with materials and equipment.
 2. Do not load structure with weight that will endanger structure.
 3. Confine operations at the site to the areas permitted. Portions of the site beyond areas in which work is indicated are not to be disturbed.
 4. Keep existing driveways and entrances serving the premises clear and available at all times. Do not use parking for storage of materials.
 5. Move stored products which interfere with the District operations and other contractors.
 6. Assume full responsibility for the protection and safekeeping of stored products.
 7. Obtain and pay for use of additional storage land work areas needed for Contractor operations if necessary.
 8. Provide resources for trash removal. Facility dumpsters and trash cans cannot be used for Contractor's trash disposal. Contractor shall not interfere with District waste facilities and scheduled trash pickup.
 9. Lock automotive type vehicles and other mechanized or motorized construction equipment when parked and unattended. Do not leave vehicles or equipment unattended with the motor running or ignition key in place.
 10. Areas of the site which will be occupied by the Contractor or impacted by construction shall be restored to existing conditions. Contractor is responsible for damage caused by construction activities to playgrounds and surfaces.
 11. It is understood that the Contractor has the most knowledge about staging construction and the extent of restoration required. The Contract Documents therefore do not indicate new construction to replace existing.
 12. Landscaping damaged by the Contractor or associated activities shall be repaired to original conditions. All newly seeded or planted areas will be maintained through a period of establishment as determined as reasonable but not less than one growing season. Contractor shall follow requirements as indicated below:
 - a. The Contractor shall be responsible for protecting seeded areas from damage and maintaining seeded areas as necessary to establish a complete coverage of the specified vegetation in a healthy and growing condition for 365 days from the date of substantial completion of the project.
 - b. Mowing: Mow all seeded areas as required to maintain in a healthy growing condition, and to control the germination and spread of noxious weeds. Mow a minimum of once per maintenance period. Line trimmers may be used where appropriate.
 - c. Re-Seeding: Upon detection of damaged or failing areas and areas showing unsatisfactory growth and coverage, the Contractor shall restore the area as necessary to establish a complete cover crop. Reseed using the seed mixes specified.
 - d. Provide necessary watering of seeded areas via temporary irrigation system or hand watering. Any irrigation system is subject to requirements for system use, such as approved backflow devices. Perform necessary site visits and observations to maintain the proper amounts of moisture in soils to promote healthy and vigorous plant growth. Correct conditions of over or under-watering as may be determined by weekly observations during the irrigation season.

13. Contractor is to protect existing trees in the vicinity of construction operations. No Work, staging, or vehicle traffic is to extend into the drip line of a tree. Contractor will be responsible for any and all penalties, fines, arborist reports, inspections, and required remediation steps for causing damage to a tree or its root system.
14. Contractor's Use of the Existing Building:
 1. Maintain the existing building in a safe and weather tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect building during construction period.
 2. Keep public areas such as hallways, stairs, elevator lobbies, and toilet rooms free from the accumulation of waste materials, rubbish, or construction debris.
 3. Contractor may use existing restroom facilities, provided they are maintained, clean, and free of debris at the end of each work shift. Owner will designate which restroom facilities are for the contractor to use.
 4. Contractor to insure that non-construction areas remain free of construction dust throughout the course of the project.
 5. In the event of a water intrusion incident, the Contractor shall follow the below procedures:
 - a. Notify the District of the incident immediately.
 - b. Investigate the source of the water intrusion, and put measures in-place to stop the infiltration of water or moisture into the building.
 - c. Hire a professional remediation company that is pre-approved by the District to manage and remediate the damage within 24 hours of becoming aware of the event.
 - d. If the areas impacted by the water intrusion are not sufficiently dried-out (as determined by moisture testing performed by a certified professional) within 48 hours to stop any potential mold growth; Contractor is to pay for a baseline mold test to be performed to establish whether any mold has started to grow. A final mold test will be required to clear the area after the remediation work is complete.
 - e. In addition to returning the affected areas to their original condition, Contractor is also responsible for replacing any FF&E that is damaged, paying for the necessary relocation of school operations, and paying for the District's employees and agents involved in managing and/or remediating the damage.
 6. Shrouding of existing furnishings, fixtures, and equipment:
 - a. Contractor is to gather and shroud all furnishings near the work zone to protect them from dust, debris, and liquids.
 - b. Furnishings are to be replaced to their former position at the end of the Work.
 - c. Maintain clearance for circulation and egress within the halls.
- C. Contractor's Site Conduct:
 1. Identifying name tags will be worn at all times. Follow all requirements for background checks and badging as outlined in section 110 of the General Conditions of the Construction Contract.
 2. No loitering in the school buildings.
 3. The site is a tobacco-free site. This means no smoking or chewing on the property.
 4. Keep the project free of pop cans, lunch wrappers, etc.
 5. The supervisor will review the scheduling of any work that is excessively noisy.
 6. Profanity is not acceptable.
 7. The wearing of clothing with logos displaying alcohol, tobacco, illegal substances, or suggestive themes is not acceptable attire.
 8. The Contractor, the Contractor's employees and all subcontractor's and subcontractor's employees who perform Work will be required to comply with the Owner's policies and procedures.
 9. Beyond courtesy, there should be no interaction between Contractor and students.
- D. Emergency Building Exits During Construction:

1. Maintain required access to existing emergency exits as required by governing jurisdiction. Any changes made to the egress plan by the Contractor shall be the Contractor's responsibility to get it professionally designed and approved by the governing jurisdiction.
2. Protect the public and the District's staff from construction hazards in the emergency egress pathways.
3. Protection barriers from falling material hazards shall be professionally designed and submitted to the District for approval.

PART 2 PRODUCTS (NOT USED)

PART 3 – EXECUTION – NOT USED

END OF SECTION 01 11 00

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related requirements.
- B. Access to site.
- C. Coordination with occupants.
- D. Use of site.
- E. Standard working hours/days.
- F. Deviation from standard hours/days.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 ACCESS TO SITE

- A. Contractor shall limit use of premises for Work and for construction operations.
- B. There shall be no access through or from adjacent parks or residences.
- C. Coordinate use of premises under direction of the District.

1.04 USE OF SITE

- A. Contractor shall have full access to the Site but shall limit access to locations and schedules in advance with Owner. Contractor shall direct all construction vehicle and delivery traffic along an access route as approved by the Owner. Provide schedule to Owner for deliveries.
- B. Contractor shall professionally prepare a site logistics plan that defines Contractor areas for work, access, staging and storage.
- C. Contractor shall submit staging and logistics plan to District and governing authorities for review and approval prior to commencement of Work.
- D. Contractor shall limit use of premise for Work and for storage to allow for:
 - 1. District occupancy and operations.
 - 2. Coordinated use of premises under direction of Owner.
 - 3. Full responsibility for protection and safekeeping of products under this Contract stored at site.
 - 4. Moving stored products, under Contractor's control, which interfere with operations of District or a separate Contractor.
 - 5. Obtaining and paying for use of additional storage or work areas needed for operations.
 - 6. Conformance to fire / life safety requirements and fire equipment access.
 - 7. Worker vehicle parking on-site.
- E. The existing fire alarm system and fire sprinkler system shall remain operational twenty four (24) hours/day, seven (7) days/week. If at any time during the Project the existing system is not fully operational the Contractor, at its own expense, shall provide a "Fire Watch" acceptable to the Owner and authority having jurisdiction until either the existing system is made fully operational or the new system is fully installed, tested and accepted.
- F. Work on weekends, evenings or holidays may be required to meet the project schedule. Provide hours notification to the Owner to ensure necessary inspections, monitoring, testing, etc. are provided during these work hours.
- G. The Contractor shall diligently maintain all construction zone barricades and fencing if required.
 - 1. Fence panels shall be secured with two fence clamps per joint.
 - 2. The Contractor shall secure end panels in a manner acceptable to the Owner.
 - 3. The use of tie wire will not be an acceptable method for securing fence panels.
 - 4. Construction zone gates shall be secured with chains and District provided padlocks.

1.05 WORKING HOURS/DAYS

- A. Work hours shall be traditional non-school hours, evenings and weekends. Access to the buildings will be provided during regular work hours based upon days when students are not present, and/or according to school staff needs. Contractor is required to provide onsite management during the work.
- B. Exterior work and interior work that generates noise shall be performed in accordance with local codes.
- C. Contractor is required to work at their own expense any time that they are behind schedule (according to the accepted Project Construction Schedule).

1.06 DEVIATION FROM STANDARD HOURS/DAYS

- A. For any deviation from the above stated working days/times, Contractor shall submit a request in writing to the District at least 48 hours prior to the date in question. While the District cannot assure approval in every instance, efforts shall be made to accommodate such requests.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONTRACT TIME / MILESTONE SCHEDULE

- A. All Phase times indicated are from start of Contractor's access to work area to Substantial completion.

END OF SECTION 01 14 00

SECTION 01 18 00
PROJECT UTILITY SOURCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related sections.
- B. Access and Start-Up/Termination.
- C. Shut-Off procedures.
- D. System survey.
- E. Emergency Shut-Off survey.
- F. Payment provisions.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 RELATED SECTIONS

- A. Section 01 73 00 - Execution Operation and Maintenance Data.

1.04 ACCESS AND START-UP/TERMINATION

- A. Contractor shall contact and make arrangements with utility providers to ensure proper access to temporary power, water and other utilities as needed to conduct the work. Contractor shall not disconnect any existing breakers to use for temporary power without approval from the District, and shall not install new breakers for temporary power without first confirming that the panel has adequate capacity for the new breakers.
- B. Upon completion of the Work, Contractor shall ensure that all utility services have been appropriately terminated in accordance with the Contract Documents and utility purveyor requirements.
- C. Refer to Section 01 73 00.

1.05 SHUT-OFF PROCEDURES

- A. Contractor shall be responsible for demolition of utility systems including cutting, capping and system shut down in accordance with local utility service purveyor requirements.
- B. Contractor shall notify District a minimum of three working days prior to any proposed shut down and shall provide written documentation of shut-down procedures as well as requirements for future system restart. Standard District Form to be used.
- C. Domestic water main valves cannot be turned-off without a District representative being present. Any damage caused to the auto-flush valves, water filters, or any other plumbing fixture due to unauthorized shut-down of the system will be repaired at the Contractor's expense.
- D. Fire alarm systems must be put in test while they are being worked on. At the end of every work day, the systems must be back online and 100% operational. If any zone is not functioning properly, Contractor is to post a "fire watch". If the Contractor does not post a fire watch, the District will at the Contractor's expense. In addition to the cost for the fire watch, the Contractor will be charged for all management time spent managing the situation, and any additional related incidental costs.
- E. Fire sprinkler systems are not to be modified without approved submittals clearly defining the work to be performed, a fire sprinkler permit in-hand, and a District representative present at the time the system depressurized and drained. If the system is not 100% operational at the end of every work day, then Contractor is to notify the District and by-pass the tamper flow switches on the fire alarm system.
- F. Power to breaker panels and the District's equipment is not to be turned-off without approval from an authorized District representative. Any costs incurred by the District for having to re-start or re-program any of the mechanical or electrical systems due to unauthorized shut- down of any power supply will be the Contractor's responsibility.

1.06 EMERGENCY SHUT-OFF SURVEY

- A. Before construction begins Contractor shall field survey the building/buildings and site and contact the appropriate Beaverton SD personnel to develop an Emergency Shut-off Plan.
- B. The plan will show graphically all shut-off locations for utilities clearly identified along with any special instructions and contact procedures.
- C. The Contractor shall assemble any specialty tools required and keys for any locked areas.
- D. The Emergency Shut-off Plan shall be posted in Contractor's construction office with a copy of all items to be located in the front office.

1.07 PAYMENT PROVISIONS

- A. District shall pay for permanent and temporary utility services.
- B. Contractor shall use due diligence to observe sustainable and conservational utility use practices.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 18 00

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements
- B. Substitution Procedures (During Construction)
- C. Product Substitution Procedures (During Construction)
- D. Substitution Request Timing (During Construction)

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction

1.03 SUBSTITUTION PROCEDURES (DURING CONSTRUCTION)

- A. All substitution requests shall be submitted as a Request for Information (RFI).
- B. Contractor shall submit the substitution request, along with all associated cost adjustments using the District approved form.
- C. Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without first being approved through the RFI process.
- D. In making request for substitution, Contractor represents that:
 - 1. It has personally investigated proposed product or method, and have included a side-by-side comparison in the substitution request.
 - 2. It will coordinate installation of accepted substitution into Work, making such changes as may be required for Work to be complete in all respects at no additional cost to District once the substitution and related cost impacts have been accepted.
 - 3. It waives all claims for additional costs or time extensions related to substitution which consequently become apparent after the substitution is approved.
 - 4. It will reimburse District for review or redesign services associated with re-approval by authorities.
 - 5. Should any proposed product substitution require any redesign work to accommodate the substitute product, costs for such re-design work shall be included in the proposal amount and shall be paid to the District consultants for the required re-design work.
- E. District shall notify Contractor in writing of decision to accept or reject request via the RFI process.
- F. Upon receiving the District's decision to proceed with the substitution, Contractor is to initiate a PCO or Change Request to modify the contract and submit any additional submittals required as a result of changing products.

1.04 PRODUCT SUBSTITUTION PROCEDURES (DURING CONSTRUCTION)

- A. Include in each request complete a side-by-side analysis of the following items:
 - 1. Product identification, including manufacturer's name and address.
 - 2. Manufacturer's literature.
 - 3. Product description.
 - 4. Performance and test data.
 - 5. Reference standards.
 - 6. Samples, when appropriate.
 - 7. Name and address of similar projects on which product was used and date of installation.
 - 8. Product availability and lead-time for delivery.
 - 9. Detailed description of proposed method and drawings illustrating methods.
 - 10. Itemized comparison of proposed substitutions with products and/or methods specified.
 - 11. Data relating to changes in Project schedule.
 - 12. Accurate cost data on proposed substitution in comparison with product or method specified.

1.05 SUBSTITUTION REQUEST TIMING (DURING CONSTRUCTION)

- A. Substitution may be considered for one or more of the following conditions:
 - 1. Product unavailability beyond control of Contractor, such as strikes, lockouts, and discontinuance by the manufacturer or his authorized supplier.
 - 2. Requirements for compliance with final interpretation of code requirements or insurance regulations.
 - 3. District or consultant requested substitution.
 - 4. If it can be shown that specified product or system is not well suited for proposed application, or that another is superior and/or less costly. Attach detailed documentation including cost savings/increase.
 - 5. Subsequent information or data discloses inability of specified product to perform properly in the application and/or for the purpose for which it was intended.
 - 6. Manufacturer's or fabricator's refusal to certify or guarantee performance of specified product as required.
 - 7. Subsequent information that a long delivery date will not be compatible with the Contract construction period.
 - 8. Proof for any of the above set forth conditions shall be submitted to the District representative in writing with all pertinent data in the form of a Change Order Request.
- B. District reserves the right to reject any and all substitution requests for any reason, without obligation or liability.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 25 00

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Requests for Information (RFI).
- C. Architectural Supplemental Instructions (ASI).
- D. Construction Change Directives (CCD).
- E. Change Order Requests (COR).
- F. Change Orders.

1.02 RELATED REQUIREMENTS

- A. Section 01 31 23.
- B. Engineer Supplemental Instructions (ESI).

1.03 REQUESTS FOR INFORMATION

- A. Initiating the Request for Information (RFI).
 - 1. Where the Contractor requires additional information to assist in interpreting the documents or understanding how to apply the provisions of the Contract Documents, the Contractor shall submit an RFI to the Engineer to distribute as appropriate to the Project team.
 - 2. Upon submitting an RFI, Contractor is to determine if there are portions of the ongoing Work that are directly affected by the issue described in the RFI that need to be stopped until further direction is received, and they are to notify the Engineer and Owner of this in writing. The Engineer and/or Owner will direct Contractor as to whether or not they are to stop working in those areas.
- B. All requests shall include the following:
 - 1. RFI number (assign sequential numbers to RFIs).
 - 2. Specific reference to the drawings, specifications or field conditions that initiated the need for interpretation, including drawing number(s), detail number(s), and specification section numbers(s).
 - 3. List of subcontractors involved.
 - 4. Date of request.
 - 5. Date that response is needed.
 - 6. Background: State purpose of Request. Provide concise information necessary for the Architect's understanding of the Request.
 - a. State Contractor's interpretation of the requirements of the Contract Documents.
 - b. Provide statements in condensed and precise question format, and where appropriate, compose in such a way that "yes" or "no" would be acceptable response.
 - c. If the statement of the question for which interpretation is requested is ambiguous or unclear, the Request shall be considered incomplete.
 - d. Use additional forms, diagrams or marked-up Contract Drawings where necessary.
 - 7. Reason for need for information (unanticipated field condition, conflict in documents, change in requirements of third party such as code entity).
 - 8. Suggested options for resolution.
 - 9. Indication of whether or not the issue appears to have potential impact on the Contract Sum or Contract Time. Provide rough-order-of-magnitude cost and time estimate.
 - 10. Space for Engineer's response.
- C. Limit Requests for Information to not more than one issue or question.
 - 1. Avoid questions that may include multiple sub-issues.
 - 2. If Engineer determines that a Request contains more than one issue, Contractor will be required to resubmit.

- D. Engineer's Review
 - 1. After receipt of an RFI, Engineer will determine whether the Request is complete.
 - 2. If Request is determined to be incomplete, Engineer will notify Contractor in writing of the deficiencies. Engineer will take no further action on incomplete RFI until deficiencies are remedied.
 - 3. Allow 3 working days for review by Engineer.
 - a. If a longer review time is deemed necessary, Engineer will notify Contractor of the anticipated response time, within 3 working days of receipt of the complete RFI.
 - b. Indicate "URGENT" on RFIs which may impact the Project Schedule to notify Engineer of priority.
 - c. Urgent RFIs will take precedence and be answered as soon as possible.
- E. Engineer's Response.
 - 1. Responses issued by Engineer will be to explain and clarify the intent of the Contract Documents.
 - 2. Responses of the Engineer shall be consistent with the intent of the Contract.
- F. Distribution and Notification
 - 1. Upon receipt of the Engineer's response, Contractor shall distribute copies to the initiator of the request and to all affected parties.
 - 2. Contractor is responsible for immediately implementing the changes to the Contract Documents in accordance with the Engineer's response. Contractor shall be responsible for costs incurred due to continuing with Work that is contrary to the direction given in the Engineer's response.
 - 3. Contractor is to notify the Owner within 48 hours of receiving the Engineer's response of any cost or schedule impacts due to the changes made to the Contract Documents by the Engineer's response.
 - 4. If there is a cost impact or a schedule impact due to the Engineer's response, Contractor shall process a Change Order Request and obtain Owner's approval before proceeding with the changes. While waiting for the Owner's approval, Contractor shall not proceed with Work that will need to be redone if/when the cost or schedule impacts are approved.
- G. Coordination With Contractor Submittals
 - 1. Contractor shall take special care to ensure that RFI responses are included and coordinated with all trades and required project Submittals and Shop Drawings.
 - 2. Submittals and Shop Drawings that do not incorporate all RFI responses shall be returned to Contractor without review as incomplete.
- H. Administrative Costs
 - 1. Requests for Information (RFIs) for information that is already contained or provided for in the Contract Documents may result in additional administrative costs to the Owner, which the Owner may charge to the Contractor.
 - 2. Requests for Information (RFIs) for solutions to Contractor's errors may result in additional administrative costs to the Owner, which the Owner may charge to the Contractor.
 - 3. Requests for Information (RFIs) for Substitution Requests may result in additional administrative costs to the Owner, which the Owner may charge to the Contractor.

1.04 ENGINEER SUPPLEMENTAL INSTRUCTIONS

- A. The District, without invalidating the Contract, may issue Engineer Supplemental Instructions (ESI) authorizing changes in the Work.
- B. Distribution and Notification
 - 1. Upon receipt of the ESI, Contractor shall distribute copies to all affected parties.
 - 2. Contractor is responsible for immediately implementing the changes to the Contract Documents in accordance with the ESI. Contractor shall be responsible for costs incurred due to continuing with Work that is contrary to the direction given in the ESI.
 - 3. Contractor is to notify the Owner within 48 hours of receiving the ASI of any cost or schedule impacts due to the changes made to the Contract Documents by the ESI.

4. If there is a cost impact or a schedule impact due to the ESI, Contractor shall process a Change Order Request and obtain Owner's approval before proceeding with the changes. While waiting for the Owner's approval, Contractor shall not proceed with Work that will need to be redone if/when the cost or schedule impacts are approved.
- C. Coordination With Contractor Submittals
 1. Contractor shall take special care to ensure that ESI's are included and coordinated with all trades and required project Submittals and Shop Drawings.
 2. Submittals and Shop Drawings that do not incorporate all ESI's shall be returned to Contractor without review as incomplete.

1.05 CONSTRUCTION CHANGE DIRECTIVES

- A. Where the District has requested a change to the Work and the District and Contractor cannot agree to the terms of adjustment to the Contract Sum or Contract Time, the Engineer shall issue a Construction Change Directive compelling to the Contractor to commence with the change, tracking both the time and cost of the work until such time as the Contractor and District can come to an agreement.
- B. Construction Change Directives shall contain a complete description of the changes in the work and shall designate the method to be followed to determine changes in the Contract Sum or Contract Time. Contractor may be required to provide a rough-order-of-magnitude cost/time estimate.
- C. Contractor shall maintain detailed records on a time and materials basis of the Work required.
- D. Upon completion of the change in the Work, the Contractor shall submit an itemized account and supporting data necessary to substantiate the cost and time adjustments to the Contract for preparation of a Change Order by the District's Representative.
- E. Payment to the Contractor shall not be made on basis of a Construction Change Directive until it is made into a Change Order approved by the District, its Representative, the Contractor and the Engineer. Portions of a Construction Change Directive shall not be eligible to be made into a Change Order for partial payment.

1.06 CHANGE ORDER REQUESTS

- A. Contractor shall process a Change Order Request (COR) for changes to the Contract Documents that result in revisions in the Contract Sum or Contract Time.
- B. A separate COR shall be created for each issue.
- C. Contractor is to submit the COR to the District's Representative for review.
- D. The District's Representative shall review the COR's scope and pricing, and may request additional information or clarification from the Contractor.
- E. Upon approval of the COR by the District's Representative, the Contractor can officially proceed with the changes.
- F. Approved COR's will be rolled-up into a Change Order on a monthly basis.

1.07 CHANGE ORDERS

- A. Change Orders shall be recorded as a revision to the Contract for Construction and Contractor shall immediately upon execution add their content and value to both the Construction Schedule and the Schedule of Values.
- B. Applications for Payment shall include all executed change orders in order to be considered complete and acceptable for payment processing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 26 00

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Schedule of Values.
- C. Progress Payment Procedures.
- D. Payment for Stored Materials.
- E. Payment for Deposits on Ordered Materials.
- F. Payment Procedures for Testing Laboratory Services.

1.02 RELATED REQUIREMENTS

- A. The General Conditions to the Contract.

1.03 SCHEDULE OF VALUES

- A. Within 10 days of the Contract Award, the Contractor shall submit to the District for review and acceptance, the Schedule of Values.
- B. The Schedule of Values shall allocate the entire Contract Sum among the various portions of the Work and shall be prepared in such form as approved by the District and supported by such data to substantiate its accuracy.
- C. The Schedule of Values shall be itemized to the level of detail as requested by the Owner/Engineer.
 - 1. Separate the Contract Sum into Project Sites.
 - 2. Separate the costs for each Project Site into Phases.
 - 3. Separate line items for labor and materials.
 - 4. No one line item shall be more than 5% of the Contract Sum.
- D. District shall review and accept the Schedule of Values for use in the preparation of Applications for Payment.

1.04 PROGRESS PAYMENT PROCEDURES

- A. Each Application for Payment shall be submitted based on the procedures outlined in the Contract.
- B. Applications for Payment that have an inflated % complete for any give line item shall be rejected. Contractor shall revise and resubmit the Application for Payment with the corrected % complete. The Contractor shall be responsible for hardships due to delays in the approval of the Application for Payments that are caused by errors in the Applications.
- C. General Conditions shall be billed monthly at the same % complete as the total % complete for that Application for Payment.

1.05 PAYMENT FOR STORED MATERIALS

- A. Contractor may be entitled to receive payment for stored materials provided the following conditions have been met:
 - 1. A valid off-site stored materials insurance certificate is to be provided to the District. The policy needs to reference the project that the materials are for, and the value of the policy needs to meet or exceed the value of stored materials. The District is to be listed as additional insured on the policy.
 - 2. Materials shall be clearly labeled as District property and specific to the project, and shall be stored separately from other materials.
 - 3. The District shall obtain verification from an independent third party that all items are present within the warehouse. The cost of the initial verification process will be the responsibility of the Contractor to pay for.

4. Keys and alarm codes are to be provided to the District representative for unfettered access to the warehouse until the stored materials are delivered to the project site. Periodic unannounced inspection visits to the warehouse may be made a District representative. If the materials are removed without permission from the District, Contractor shall immediately reimburse the District for the entire payment made for the stored materials.
5. Digital photos of the off-site stored materials labeled for the project are to be submitted with the Application for Payment.
6. Contractor is to provide an executed bill of sale as proof of payment for stored materials.
7. Verification of stored materials and partial payment for such materials do not constitute acceptance on the part of the District. In the event that materials stored are found to be unsuitable for installation or incorporation into the Work for any reason, Contractor shall bear full responsibility for any and all corrections needed.
8. District shall not be responsible for any additional costs incurred for the storage of materials unless such storage is the result of and a part of an approved Change Order where the District is found to be responsible for such costs.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 29 00

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Project Coordination.
- C. Construction Organization and Start-Up.
- D. Construction Coordination.
- E. Coordinating Subcontractors Work.
- F. Project Meetings.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction

1.03 PROJECT COORDINATION

- A. A. Before submitting the Bid to the District, and continuously after the execution of this Contract, the Contractor shall carefully study and compare the Contract Documents and shall at once report to the District, any error, inconsistency or omission it may discover including any requirement which may be contrary to any law, ordinance, rule, regulation or order of any public authority bearing on the performance of the Work.
- B. B. By submitting bid for this Contract and the Work under it, the Contractor agrees that the Contract Documents, along with any addendum's or other supplementary written instructions issued that have become a part of the Contract Documents, appear accurate, consistent, and complete insofar as can reasonably be determined. The Contractor shall do no Work without Contract Documents and, when required, reviewed Shop Drawings, Product Data or samples for such portions of the Work.

1.04 CONSTRUCTION ORGANIZATION AND START-UP

- A. Establish on-site lines of authority and communications by attending Pre-construction Meeting and Progress Meetings as required by the Engineer, District and District's Representatives.
- B. Comply with procedures for intra-project communications including but limited to:
 - 1. Submittals
 - 2. Reports and records
 - 3. Recommendations
 - 4. Coordination drawings
 - 5. Schedules
 - 6. Resolution of conflicts

1.05 CONSTRUCTION COORDINATION

- A. General Coordination:
 - 1. Coordinate various elements of the work and entities engaged to perform work.
 - 2. Coordinate the work with existing facilities/conditions, and with work by separate contractors and by the Owner.
- B. Mechanical, electrical & plumbing drawings:
 - 1. Mechanical, Electrical, and Plumbing Contract Drawings are diagrammatic. Additional offsets and bends may be required.
 - 2. Install additional offsets and bends in the systems where required by field conditions.
 - 3. The Engineer may make minor adjustments in fixture, outlet, grille, louver, or ventilator locations prior to rough-in work with no additional cost.
- C. Clearances:

1. Provide adequate clearance between Structural, Mechanical, and Electrical Systems. Verify physical dimensions of equipment and its available space. Check access routes through concealed or existing spaces for installation of systems or equipment.
2. Review the Construction Documents for possible conflicts prior to rough-in. Contractor is responsible for verification that equipment will fit in the space provided. Resolve conflicts with the Engineer prior to rough-in work.

1.06 COORDINATING SUBCONTRACTORS' WORK

- A. Coordinate the Work of all Subcontractors and make certain that, where the Work of one trade is dependent upon the Work of another trade, the Work first installed is properly placed, installed, aligned, and finished as specified or required to properly receive subsequent materials applied or attached thereto.
- B. Direct Subcontractors to correct defects in their workmanship when subcontractors of subsequent materials have a reasonable and justifiable objection to conditions of work.
- C. Do not force Subcontractors to apply or install products to improperly finished product.
- D. Coordinate changes to assure that:
 1. Requirements of Contract Documents are fulfilled.
 2. Changes in Contract requirements of all affected trades are reflected in executed Change Orders.
- E. Scheduling and Installation Sequence:
 1. Coordinate scheduling, submittals, and Work of various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
 2. Schedule work in accordance with current Project Construction Schedule.
 - a. Coordinate schedules of all trades.
 - b. Verify timely deliveries of products for installation by other trades.
 - c. Verify that labor and equipment are adequate for Work and schedule.
 - d. Verify that material deliveries are adequate to maintain schedule.
 - e. Owner shall not pay for expedited shipping of materials and equipment in order to meet the scheduled completion date. These costs are to be included in the Contractors bid.

1.07 PROJECT MEETINGS

- A. Preconstruction Meetings:
 1. Engineer will administer preconstruction meeting and provide meeting agenda and minutes for execution of Owner-Contractor Contract and exchange of preliminary submittals.
- B. Progress Meetings
 1. Contractor shall attend the weekly project site meetings throughout the course of the Work. Progress meeting times and locations to be determined. Engineer will conduct and provide agenda and minutes. Contractor will provide schedule updates. Necessary logs (i.e., submittals, RFI's, COP, etc.) will be provided by either the contractor or engineer through the use of the E-Builder system.
 2. The Engineer shall record the minutes at the meetings which shall be distributed by the Engineer within two days to Owner, Construction Manager, Contractor, participants at the meetings, and those affected by decisions made at the meetings.
 3. Attendees shall include Contractor's project manager and superintendent, Owner, Construction Manager, and Engineer as appropriate to the topics for each meeting.
 4. Suggested agenda topics: informational items, safety, schedule review, RFI & ASI review, submittal review, Contractor issues, design issues, owner issues, change order requests and pay applications, and closeout.
- C. Pre-Installation Meeting
 1. Prior to commencement of critical new activities on site, Contractor shall conduct a Pre-Installation Meeting. Contractor shall ensure that all relevant subcontractors are

present inclusive of those performing work immediately prior and subsequent to the subject activity as well as those who are impacted by the Work.

2. The purpose of the meeting is to review field conditions to confirm that the site and all previous work is ready for the commencement of the new activity, confirm clear understanding of the intention of the plans and specifications and to identify potential risks and resolutions to those risks related to the proposed work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 31 00

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Scheduling of Work.
- C. Construction Progress Schedule.
- D. Three Week Look Ahead.
- E. Recovery Schedule.
- F. Submittals Schedule.
- G. Deferred Submittals.
- H. Site Specific Safety Plans.
- I. Site Specific Staging and Logistics Plan.
- J. Contractor Health and Safety Evaluation.
- K. Construction Progress Reporting.
- L. Periodic Work Observation.
- M. Photographic Documentation.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 SCHEDULING OF WORK

- A. The primary objectives of the project scheduling program are as follows:
 - 1. To ensure the adequate planning, scheduling, and execution of the construction activities so they may be prosecuted in an orderly and expeditious manner within the Contract Time and the Milestones stipulated by the Contract.
 - 2. To provide optimum coordination between Subcontractors.
 - 3. To establish the basis for measuring and monitoring individual Contractor progress and overall project progress.
 - 4. To detect problems for the purpose of taking corrective action to maintain the scheduled program and to provide a mechanism or tool for determining and monitoring such corrective actions.
- B. If the Contractor should desire or intend to complete the Work earlier than any required Milestone or Completion date, the District, Engineer or the District's Representative shall not be liable to the Contractor for any costs or other damages should the Contractor be unable to complete the Work before this earlier date. The duties, obligations and warranties of the District to the Contractor shall be consistent with and applicable only to the completion of the Work on the Milestone and Completion dates required in the Contract, unless the District, the District's Representative and the Contractor otherwise agree in writing.

1.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Pursuant to the General Conditions of this Contract, the following additional scheduling requirements are a part of this Contract.
- B. The Construction Progress Schedule shall be created using the current version of MS Project or approved equal using the Critical Path Method (CPM). Project schedule must be approved prior to first payment request.
- C. Work under this Section shall consist of completing a Construction Progress Schedule showing in detail how the Contractor plans to execute and coordinate the Work.
- D. Each work item on the Construction Progress Schedule, as well as being correlated to the payment document, shall be broken into feasible work segments/activities (where practicable)

with individual starting and stopping dates. Format and activities included shall be subject to the approval of the Owner and Engineer.

- E. Work shall be segmented to demonstrate its relationship to the various Milestone Dates. Activity titles shall be self-explanatory and abbreviations shall be shown in the legend.
- F. The schedule submitted for Owner review and acceptance must be provided in both a PDF format and an electronic format (Electronic Format - Information / data released in a native scheduling software application format). Any subsequent modifications / updates to the schedule must also be provided to the Owner in an electronic format.

1.05 THREE WEEK LOOK AHEAD SCHEDULE

- A. Each week the Contractor shall prepare and present an update schedule showing the planned activities for the next three weeks and 1 week prior. The schedule shall be coordinated with the master schedule and accurately portray activities completed and activities planned for the upcoming weeks. Unless otherwise directed by the Owner, the Contractor shall present this schedule at the weekly meeting.
- B. Provide copies to the participants at the time of the weekly Progress Meeting.
- C. Format shall be 11" by 17" or as necessary to be easily legible.

1.06 RECOVERY SCHEDULE

- A. Should any conditions exist, such that certain activities shown on the Contractor's Construction Progress Schedule fall behind schedule to the extent that any of the critical path Milestones or Completion Dates are in jeopardy, the Contractor shall be required to, at no cost to the District, prepare and submit a supplementary Recovery Schedule. The Recovery Schedule shall be in a written form with appropriate details including an explanation and display on how he/she intends to reschedule those activities to regain compliance with the Construction Progress Schedule during the immediate subsequent pay period.
- B. The Contractor and District's Representative shall do the following after determination of the requirement for a Recovery Schedule:
 - 1. Within three (3) calendar days, the Contractor shall present to the District's Representative the Recovery Schedule.
 - 2. The Recovery Schedule shall represent the Contractor's best judgment regarding how to reorganize and accelerate the Work to get back on schedule within the immediate subsequent pay period. The Recovery Schedule shall be prepared to a similar level of detail as the Construction Progress Schedule.
- C. Five (5) calendar days prior to the expiration of the Recovery Schedule, the District's Representative and the Contractor will meet at the job site to determine whether the Contractor has regained compliance with the Construction Schedule. At the direction of the District's Representative, one of the following will happen:
 - 1. If, in the opinion of the District's Representative, the Contractor is still behind schedule, the Contractor in conjunction with the District's Representative will prepare another Recovery Schedule, at the Contractor's expense to take effect during the immediate subsequent pay period.
 - 2. If, in the opinion of the District's Representative, the Contractor has sufficiently regained compliance with the Construction Schedule, the use of the Construction Schedule will be resumed.

1.07 SUBMITTALS SCHEDULE

- A. In conjunction with the preparation of the Construction Progress Schedule, the Contractor shall prepare a Submittals Schedule that shall outline all required submittals and when they are required to be approved based on ordering lead times and the incorporation of products into the Work in conformance with the Construction Progress Schedule.
- B. Contractor shall then reverse engineer the Submittals Schedule to determine when submittals need to be provided to the District and design team, noting latest approval dates and factoring in time for the re-submittal of items if necessary.

- C. The Submittals Schedule shall be clearly identified within Construction Progress Schedule and shall be updated and reviewed at each Project Progress Meeting.
- D. Contractor shall fill out Owner submittal log that will include all dates associated with submittals. The log will be updated accordingly and submitted weekly for approval. Contractor shall use Owner provided submittal log with dates.

1.08 DEFERRED SUBMITTALS

- A. Certain components of the Work under this project are Delegated Design. It is the Contractor's responsibility to coordinate and assume or assign to subcontractors the complete responsibility for the design, calculation, submittals, fabrication, transportation and installation of the Delegated Design portions or components as required. Delegated Design components of the Work are defined as complete operational systems, provided for their intended use.
- B. Submit deferred submittals for Delegated Design elements to the governing agency for the separate approval of each Delegated Design item.
- C. Owner shall not be responsible to pay for any delays, additional products, additional hours of work or overtime, restocking or rework required due to failure by the Contractor or the subcontractor to coordinate their work with the work of the other trades on the project or to provide the Delegated Design portion or component in a timely manner to meet the schedule of the project.

1.09 SITE SPECIFIC SAFETY PLAN

- A. In an effort to reduce accidents and maintain a safe work site, the Contractor, prior to any work on site, shall submit to the Owner a detailed site specific safety plan which outlines, at a minimum, a detailed description of the following:
 - 1. Facility Safety and Security.
 - 2. Construction Phase Safety and Security.
 - 3. Disaster Response.
 - 4. Emergency Procedures and Protection.
 - 5. Safety and Health Procedures and Work Practices pertaining to;
 - a. Demolition
 - b. Electrical
 - c. Excavations
 - d. Fall Protection
 - e. Fire Prevention
 - f. Hazard Communications
 - g. Heavy Equipment
 - h. Housekeeping
 - i. Mobile Cranes
 - j. Scaffolding
 - k. Signs – Barricades – Fencing

1.10 SITE SPECIFIC STAGING AND LOGISTICS PLAN

- A. The Contractor, prior to any work on site, shall submit to the Owner a detailed site specific safety plan as outlined in Section 01 14 00 Work Restrictions.

1.11 CONTRACTOR HEALTH AND SAFETY EVALUATION FORM

- A. The Contractor, prior to any work on site, shall fill out the Owner's required Contractor Health and Safety Evaluation form, and participate in the completion of a Hazard and Potential Exposure Evaluation Checklist.
- B. The Owner will provide the Contractor with these forms.

1.12 CONSTRUCTION PROGRESS REPORTING

- A. The Contractor shall review the progress and quality of the Work on a daily basis and shall report on that progress daily and upload the reports to Smartsheet.
- B. Written progress reports shall include, at a minimum:

1. Project name.
2. Date.
3. Author of report.
4. Weather conditions including wind, precipitation and temperature.
5. Trades present through the reporting period and count.
6. A summary of the Work performed that day.
7. Materials and equipment delivered, utilized and/or stored on site.
8. Conformance with Contract Documents and/or any observed deviations.
9. Conformance with or deviation from Construction Progress Schedule.
10. Tests and/or inspections performed inclusive of results.
11. List of site visitors including regulatory agencies and/or testing and inspection entities.
12. Notes from any safety meetings.

1.13 PHOTOGRAPHIC DOCUMENTATION

- A. Contractor shall provide ground-level, color digital progress photos weekly for a permanent record of the Project. Photos should be dated and include a description of the picture and the camera location. Contractor shall upload all photos to Smartsheet.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 32 00

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Certificates.
- C. Electronic Submittals.
- D. Shop Drawings, Product Data, and Samples.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 CERTIFICATES

- A. When specified in an individual specification Section, submit a manufacturers' certificate to the Engineer for review, in quantities specified for Product Data.
- B. Indicate how material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates must be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.04 ELECTRONIC SUBMITTALS

- A. All documents transmitted for purposes of administration of the contract submittals and product data, are to be in electronic (PDF) format and submitted through email or a web based cloud service.
 - 1. Contractor and Engineer are required to use this electronic submittal service unless otherwise directed by the owner.
 - 2. It is the Contractor's responsibility to submit all submittal and product data documents in the following format:
 - a. Submittals shall be submitted by project and separated by specification divisions.
 - b. Bluebeam PDF Revu, www.bluebeam.com. <<http://www.bluebeam.com/>>
 - c. Limit PDF size to 10MB, unless otherwise authorized by Engineer.
 - 3. Subcontractors, suppliers, Engineer, and Engineer's consultants will be permitted to use certain modules available at no extra charge.
 - 4. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
 - 5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Project Closeout: Coordinate with Engineer and Owner to verify that archive documents have been saved and remain accessible to Engineer and Owner prior to terminating the service for the project.

1.05 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Shop Drawings are drawings, diagrams, schedules and other data specially prepared by the Contractor or any Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work. Electronic pdf to be submitted via E-Builder.
- B. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor which illustrates material, product or system for some portion of the Work.
- C. Samples are physical examples which illustrate materials, equipment or workmanship including color, texture, and pattern. Approved samples will establish standards by which the Work will be judged.

- D. The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor; all Shop Drawings, Product Data and Samples required by the Contract Documents.
- E. If the Owner Directs the Contractor to submit hard copies of shop drawings and submittal documents, the following format will apply:
 - 1. For standard manufactured items not requiring special Shop Drawings for manufacture, submit the number the Contractor requires plus four (4) copies of manufacturer's catalog sheets showing illustrated cuts of item to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring diagrams and controls, and all other pertinent information. Mark each copy to indicate actual product to be provided. Four (4) copies of reviewed submissions will be retained by the Owner, its Representatives and Engineer.
 - 2. For all other Shop Drawings, submit three (3) legible, unfolded, reproducible print(s) for each drawing. Drawings are to show connections, details, dimensions, finishes, fasteners, and any other pertinent information drawn to an accurate scale. Each drawing shall have a clear space for stamps. When phrase "by others" appears on Shop Drawings, the Contractor shall indicate on the drawing whom is to furnish material or operations so marked before submittal. When Shop Drawings are checked "revise and resubmit", the Contractor shall correct original tracing and submit a new transparency and opaque prints for review.
- F. Samples: Submit (4) sets of samples unless indicated otherwise. Two sets will be returned. Maintain one returned set at the project site for purposes of quality control comparisons.
- G. For use of all trades, the Contractor shall provide a number of prints required for field distribution.
- H. By submitting Shop Drawings, Product Data and Samples, the Contractor represents that he/she has determined and verified all materials, field measurements, and field construction criteria related thereto, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Contractor shall adhere to any supplementary processing and scheduling instruction, pertaining to Shop Drawings, as may be issued by the Owner's Representative.
- I. Engineer will review submittals for design concept and conformance with the Contract Documents, and return submittals to the Contractor for distribution with corrections noted thereon.
- J. The Contractor is advised that every Submittal returned to the Contractor, regardless of how marked, may not have been reviewed in every aspect, and that in no event should the Contractor assume that the review stamp certifies total compliance with the Contract Documents.
- K. Stamp: The Engineer will stamp each submittal to be returned with a uniform, self-explanatory action stamp, appropriately marked and executed to indicate the status of the submittal. The stamp indicates and requires the follow action:
 - 1. No Exception Taken: No further action is required.
 - 2. Make Corrections Noted: Make the corrections upon fabrication of the material only.
 - 3. Rejected: The material submitted is not acceptable and another material submission is required.
 - 4. Revise and Resubmit: The material submittal is not acceptable and it is to be elaborated upon or corrected and resubmitted prior to material fabrication.
 - 5. Submit Specified Item: Submittal is rejected and the material specified is to be submitted.
 - 6. Checking is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

- L. The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Engineer's review of Shop Drawings, Product Data or Samples unless the Contractor has received a Change Order. Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the Engineer's review thereof.
- M. The Contractor shall make any corrections required by the Engineer and shall resubmit in electronic format, or if applicable, the required number of corrected hard copies of Shop Drawings, Product Data, or new Samples. Resubmittal of Shop Drawings necessitated by required corrections shall not be a cause for extension of time. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than the corrections requested on previous submittals.
- N. No portion of the Work requiring submission of a Shop Drawing, Product Data or Sample shall be commenced until the submittal has been reviewed by the Engineer. All such portions of the Work shall be in accordance with approved submittals.
- O. Schedule of Submittals:
 - 1. Prepare and keep current, for Engineer's approval, a Schedule of Submittals which is coordinated with the Contractor's Construction Schedule and allows Engineer reasonable time to review Submittals and in such sequence as to cause no delay in the Work.
 - 2. List Submittals sequentially by date of transmittal.
 - 3. Group Submittals pertaining to a single product or assembly, showing that they will be submitted together.
 - 4. Schedule of Submittals shall include the following and per the Owner submittal form:
 - a. Submittal number.
 - b. Description of item.
 - c. Name of party responsible for preparing Submittal.
 - d. Reference to Contract Documents, Specifications and/or Drawings.
 - e. Date of anticipated transmittal to Engineer.
 - f. Date of anticipated return to Contractor.
 - g. Scheduled date for commencement of fabrication.
 - h. Estimated shipping date.
 - i. Scheduled date for installation.
 - 5. Submit initial Schedule of Submittals within calendar days after date established in Notice to Proceed for Engineer and Contracting Officer review.
- P. Time Schedule for Submittals:
 - 1. Shop drawings: Submit to the Engineer for review. The Engineer will review within 5 calendar days.
 - 2. Schedule submissions to allow ample time for ordering and delivery of materials after review.
 - 3. It is the responsibility of the Contractor to Order long-lead items in an expedited manner so as not to cause any delay in construction schedule.
 - 4. The District will not be responsible for expedited shipping costs or schedule delays resulting from late submission of long-lead item submittals.
 - 5. Product data: submit to the Engineer for review. The Engineer will review within 5 calendar days. Schedule submissions to allow ample time for ordering and delivery of materials after review.
 - 6. Samples: submit to the Engineer for review. The Engineer will review within 5 calendar days. Schedule submissions to allow ample time for ordering and delivery of materials after review.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 33 00

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Quality Control.
- C. Tolerances.
- D. References.
- E. Labeling.
- F. Mockup Requirements.
- G. Testing and Inspection Services.
- H. Manufacturers' Field Services.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Engineer and the Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

1.04 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.05 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, complies with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date of Contract Documents except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Contract Documents by mention or inference in reference documents shall not be altered by contractual relationships, duties, or responsibilities of parties in Contract, nor those of Engineer.

1.06 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.
- C. Manufacturer's nameplates, trademarks, logos, and other identifying marks on products are not allowed on surfaces exposed to view in public areas, interior or exterior.

1.07 TESTING AND INSPECTION SERVICES

- A. The Owner may select, employ, and pay for specified services of an independent firm to perform testing and inspection. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Engineer and authorities having jurisdiction.
 - 1. Laboratory: Authorized to operate in State of Oregon.
 - 2. Laboratory Staff: Maintain full-time specialist on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices that are accurate and traceable to the National Bureau of Standards or accepted values of natural physical constants.
- B. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or the Owner.
- C. Reports shall be submitted by independent firm to the Owner, Engineer, Contractor, and authorities having jurisdiction, in duplicate when so directed, indicating observations and results of tests and compliance or noncompliance with Contract Documents Submit final report indicating correction of Work previously reported as noncompliant.
- D. Contractor is to cooperate with independent firm and furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify independent firm 48 hours before expected time for operations requiring services.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- E. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- F. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- G. Agency Responsibilities:
 - 1. Test samples of mixes submitted by Contractor.
 - 2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
 - 3. Perform indicated sampling and testing of products according to specified standards.
 - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
 - 6. Perform additional tests required by Engineer.
 - 7. Attend preconstruction meetings and progress meetings.
- H. Agency Reports: After each test, promptly submit electronic copies of report to the Owner, Construction Manager, Engineer, Contractor, and authorities having jurisdiction. Written inspection or test reports shall include:
 - 1. Name of testing agency or test laboratory.

2. Date issued.
 3. Project title and number.
 4. Name of inspector and individuals present.
 5. Date and time of sampling or inspection.
 6. Identification of product and Specification Section.
 7. Location in Project.
 8. Type of inspection or test.
 9. Date of test.
 10. Complete inspection or test data.
 11. Results of tests.
 12. Interpretations.
 13. Recommendations.
 14. Conformance with Contract Documents.
- I. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency or laboratory may not approve or accept any portion of the Work.
 3. Agency or laboratory may not assume duties of Contractor.
 4. Agency or laboratory has no authority to stop the Work.

1.08 MANUFACTURER'S FIELD SERVICES

- A. When specified in individual Specification Sections, required material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment and commissioning as applicable, and to initiate instructions when necessary.
- B. Fabricator: Company specializing in performing work associated with the project with documented experience, and proper certifications.
- C. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer is subject to approval of Engineer. Observer is subject to approval by the Owner.
- D. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 40 00

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General Requirements.
- B. Products.
- C. Material and Equipment Selection.
- D. Product delivery requirements.
- E. Manufacturer's Instructions.
- F. Product storage and handling requirements.
- G. Product options.

1.02 GENERAL REQUIREMENTS

- A. General conditions of the Contract for Construction.

1.03 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- E. Furnish interchangeable components from same manufacturer for components being replaced.

1.04 MATERIAL AND EQUIPMENT SELECTION

- A. Manufactured and fabricated products:
 - 1. Design, fabricate and assemble in accordance with the best engineering and shop practices.
 - 2. Manufacture like parts of duplicate units to standard sizes and gauges and to be interchangeable.
 - 3. Where two or more items of the same kind are indicated, provided items that are identical and by the same manufacturer.
 - 4. Provide products suitable for service conditions.
 - 5. Adhere to equipment capacities, sizes, and dimensions shown or specified unless variations are specifically approved in writing.
- B. Do not use material or equipment for any purpose other than that for which it is designed or is specified.
- C. Fabricate and install equipment to deliver its full rated capacity at the efficiency for which it was designed.
- D. Select and install equipment to operate at full capacity without excessive noise or vibration.
- E. Provide electrical products with Underwriter's Laboratories Label or as approved by the local inspection authority.

1.05 PRODUCT DELIVERY REQUIREMENTS

- A. Comply with delivery requirements in Section 01 74 19 – Construction Waste Management and Disposal: Construction Waste Management Plan.
- B. Transport and handle products according to manufacturer's instructions.

- C. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- D. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

1.06 MANUFACTURER'S INSTRUCTIONS

- A. Perform work in accordance with manufacturer's printed installation instructions. Obtain and distribute copies of such instructions to parties involved in the installation.
- B. Maintain one set of complete instructions at the job site during installation and until completion.
- C. Handle, install, connect, clean, condition, and adjust products in strict accordance with manufacturer's printed instructions and in conformity with specified requirements.
- D. Consult with the Engineer for further instructions should job conditions or specified requirements conflict with manufacturer's instructions.
- E. Do not proceed with work without clear instructions.
- F. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by the Contract Documents.

1.07 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.
- C. Store sensitive products in weather-tight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.08 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of the manufacturers named and comply with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.
- D. Or Approved Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved", comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 73 00
EXECUTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Requirements.
- B. Related Sections.
- C. Starting of Systems.
- D. Demonstration and Instructions.
- E. Testing, Adjusting, and Balancing.
- F. Project Record Documents.
- G. Operation and Maintenance Data.
- H. Spare Parts and Maintenance Products
- I. Product Warranties and Product Bonds.
- J. Maintenance Service.
- K. Examination.
- L. Preparation.
- M. Execution.
- N. Protecting Installed Construction.
- O. Final Cleaning.

1.02 1.02 RELATED REQUIREMENTS

- A. General conditions of the Contract for Construction.

1.03 RELATED SECTIONS

- A. Section 01 11 00 – Summary of Work.
- B. Section 01 18 00 – Project Utility Sources.
- C. Section 01 33 00 – Submittal Procedures.
- D. Section 01 40 05 – Cutting and Patching.
- E. Section 01 77 00 – Closeout Procedures.

1.04 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems. Refer to Section 01 18 00 - Project Utility Sources.
- B. Notify Engineer and Owner seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check and approve equipment or system installation prior to startup and supervise in placing equipment or system in operation.
- H. Submit a written report according to Section 01 33 00 – Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.05 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment by qualified manufacturer's representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at designated location.
- F. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instruction.

1.06 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, RFI's, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 - 5. Identify and locate existing buried or concealed items encountered during Project.
 - 6. Measured depths of foundations in relation to finish main floor datum.
 - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 9. Field changes of dimension and detail.
 - 10. Details not on original Drawings.
- G. Record document submittal requirements specified in Section 01 77 00 – Closeout Procedures: Closeout Requirements.
- H. The contractor will be required to learn and use Owner Project Management database (E-Builder) for this project. Refer to Section 01 31 23 – Project Management Database.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data bound in 8-1/2 x 11-inch (A4) text pages, three D side ring binders with durable plastic covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
 - a. Significant design criteria.
 - b. List of equipment: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
 - c. Parts list for each component. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - d. Operating instructions. Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions. Include sequence of operation by controls manufacturer.
 - e. Maintenance instructions for equipment and systems. Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - g. Safety precautions to be taken when operating and maintaining or working near equipment.
 - h. Piping Diagram: Include Contractor's coordination drawings with color-coded piping diagrams as installed. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 - 3. Part 3: Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed. Include color-coded wiring diagrams as installed.

1.08 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
 - 1. Salvaged materials shall be palletized, shrink-wrapped, and delivered to a place and location as directed by Owner.
 - 2. Deliver to Project Site or another location as directed by Owner; obtain receipt prior to final payment.

1.09 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors suppliers, and manufacturers within ten days after completion on applicable item of Work.

- B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.
- F. Contractor to provide general 1 year labor and material warranty on all work provided under this contract, in addition to any other warranties required under other specification sections.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in Specification Sections for one (1) year from date of Substantial Completion during warranty period.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.
- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of District.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

301 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

302 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

303 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence.
 - 1. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect.
 - 4. Refer questionable visual-effect choices to Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

304 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.
- G. Refer for Section 01 11 00 – Summary of Work for more information.

305 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
- B. Employ experienced personnel or professional cleaning firm.
- C. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces.
- D. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- E. Clean permanent filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Vacuum loose granular fines from the cap sheet of new roofs so that they don't wash down the roof drains.
- H. Clean Site; sweep paved areas, rake clean landscaped surfaces.

- I. Remove waste and surplus materials, rubbish, and construction facilities from Site.
- J. Repair, patch, and touch up marred surfaces.

END OF SECTION 01 73 00

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 SECTION INCLUDES:

- A. Plan Requirements.
- B. Submittals.
- C. Construction Waste Management Plan.
- D. Construction Waste Recycling.
- E. Construction Waste Adaptive Reuse.
- F. Construction Waste Collection.
- G. Construction Waste Disposal.

1.02 RELATED REQUIREMENTS

- A. General Conditions of the Contract for Construction.

1.03 PLAN REQUIREMENTS

- A. Develop and implement construction waste management plan as approved by Engineer and Owner.
- B. Comply with the authority having jurisdiction requirements for managing and recycling construction waste.
- C. Comply with Metro and State of Oregon rules and regulations pertaining to solid waste management.
- D. Intent:
 - 1. Divert construction, demolition, and land-clearing debris from landfill disposal.
 - 2. Redirect recyclable material back to manufacturing process.
 - 3. Generate cost savings or incur minimal additional cost to Project for waste disposal.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures contains requirements for submittals.
- B. Construction Waste Management Plan: Submit construction waste management plan describing
- C. Methods and procedures for implementation and monitoring compliance including the following:
 - 1. Transportation company hauling construction waste to waste processing facilities.
 - 2. Recycling and adaptive reuse processing facilities and waste type each facility will accept.
 - 3. Construction waste materials anticipated for recycling and adaptive reuse.
 - 4. On-Site sorting and Site storage methods.

1.05 CONSTRUCTION WASTE MANAGEMENT PLAN

- A. Construction Waste Landfill Diversion: Minimize weight of construction waste materials for duration of Project through resale, recycling, or adaptive reuse.
- B. Implement construction waste management plan at start of construction.
- C. Review construction waste management plan at preconstruction meeting and progress meetings specified in Section 01 31 00 – Project Management and Coordination.
- D. Distribute approved construction waste management plan to Subcontractors and others affected by plan requirements.
- E. Oversee plan implementation, instruct construction personnel for plan compliance, and document plan results.
- F. Purchase products to prevent waste by:
 - 1. Ensuring correct quantity of each material is delivered to Site.
 - 2. Choosing products with minimal or no packaging.

3. Requiring suppliers to use returnable pallets or containers.
4. Requiring suppliers to take or buy back rejected or unused items.

1.06 CONSTRUCTION WASTE RECYCLING

- A. Use source separation method or co-mingling method suitable to sorting and processing method of selected recycling center. Dispose non-recyclable trash separately into landfill.
- B. Source Separation Method: Recyclable materials separated from trash and sorted into separate bins or containers, identified by waste type, prior to transportation to recycling center.
- C. Co-mingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.
- D. Materials suggested for recycling include:
 1. Packing materials including paper, cardboard, foam plastic, and sheeting.
 2. Recyclable plastics.
 3. Organic plant debris.
 4. Earth materials.
 5. Native stone and granular fill.
 6. Asphalt and concrete paving.
 7. Wood with and without embedded nails and staples.
 8. Glass, clear type.
 9. Metals.
 10. Gypsum products.
 11. Acoustical ceiling tile.
 12. Carpet and carpet pad.
 13. Equipment oil.
 14. Rubble.
 15. Roofing with asbestos testing.
 16. Mixed-construction debris.

1.07 CONSTRUCTION WASTE ADAPTIVE REUSE

- A. Arrange with processing facility for salvage of construction material and processing for reuse. Do not reuse construction materials on-Site except as allowed by Owner.
- B. Materials suggested for adaptive reuse include:
 1. Concrete and crushed concrete.
 2. Masonry units.
 3. Lumber suitable for re-sawing or refinishing.
 4. Casework and millwork.
 5. Doors and door frames.
 6. Windows.
 7. Window glass and insulating glass units.
 8. Hardware.
 9. Acoustical ceiling tile.
 10. Equipment and appliances.
 11. Fluorescent light fixtures and lamps.
 12. Incandescent light fixtures and lamps.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION WASTE COLLECTION

- A. Collect construction waste materials in marked bins or containers and arrange for transportation to recycling centers or adaptive salvage and reuse processing facilities.
 1. Maintain recycling and adaptive reuse storage and collection area in orderly arrangement with materials separated to eliminate co-mingling of materials required to be delivered separately to waste processing facility.

2. Store construction waste materials to prevent environmental pollution, fire hazards, hazards to persons and property, and contamination of stored materials.
3. Cover construction waste materials subject to disintegration, evaporation, settling, or runoff to prevent polluting air, water, and soil.

3.02 CONSTRUCTION WASTE DISPOSAL

- A. Deliver construction waste to waste processing facilities. Obtain receipt for deliveries.
- B. Dispose of construction waste not capable of being recycled or adaptively reused by delivery to landfill, incinerator, or other legal disposal facility. Obtain receipt for deliveries.

END OF SECTION 01 74 19

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related Sections.
- B. Preliminary Closeout Reviews.
- C. Substantial Completion Documentation.
- D. Closeout Requirements.

1.02 RELATED SECTIONS

- A. Section 01 73 00 – Execution.

1.03 PRELIMINARY CLOSEOUT REVIEWS

- A. When Contractor considers Work Substantially Complete, submit written certification that:
 - 1. Contract Documents have been reviewed.
 - 2. Contractor has inspected Work for compliance with Contract Documents.
 - 3. Work has been completed in accordance with Contract Documents.
 - 4. The Project, properties, and streets are finally cleaned of debris and dirt caused by Contractor operations.
 - 5. Work is substantially complete and ready for final inspection.
 - 6. Provide preliminary punch list identifying any known corrective items.
- B. District Representative will coordinate inspection of the Work to verify completion status as soon as possible after receipt of Contractor's certification.
- C. Should District Representative consider Work incomplete or defective:
 - 1. Representative will promptly notify Contractor in writing, through Construction Program Manager, listing incomplete or defective work.
 - 2. Contractor shall immediately remedy deficiencies, and send second written certification that Work is complete.
 - 3. Representative will coordinate re-inspection of the Work.
- D. When District, District Representative and Engineer find Work acceptable under Contract Documents, they will jointly request Contractor to make closeout submittals.
- E. Re-inspection Fees: Should more than two Substantial inspections or one Final inspection be required due to Contractor's failure to correct specified deficiencies, the Contractor shall bear all costs (including compensation for the Construction Manager, and Engineer's additional services) made necessary thereby.

1.04 SUBSTANTIAL COMPLETION DOCUMENTATION

- A. General: Contractor shall submit documentation for Substantial Completion when it is evident that the Project can be occupied for its intended use and Final Completion can be achieved within thirty (30) days. There will be one (1) Substantial Completion date for the entire project. It will be based on the completion of the work at the last building site. All warranties will start on the Substantial Completion date and this date will be indicated in the Project Schedule. A complete set of approved permit drawings and specs showing the AHJ's stamp of approval is also required.
- B. Complete the following before requesting review for certification of Substantial Completion, either for entire Work or for portions of Work.
 - 1. Create a list of items that are incomplete with the request. Include the value of incomplete Work, and reason for Work being incomplete.
 - 2. Include supporting documentation for completing as indicated in these Contract Documents.
 - 3. Submit statement showing accounting of changes to Contract Sum.
 - 4. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.

5. Deliver tools, spare parts, extra stock of material and similar physical items as directed by the Owner.
 6. Complete final cleanup requirements.
 7. Obtain Authorities Having Jurisdiction (AHJ) approvals as required and submit signed final permit in Closeout Documents.
 8. Complete major punch list items.
 9. Provide all certifications, reports and inspection records confirming that all work has been completed in accordance with the Contract Documents.
 10. Provide a complete set of approved set of permit drawings and specifications showing the Authority having Jurisdiction stamp of approval.
- C. In the event that the Contractor is not able to achieve Final Completion within 30 days, the District shall notify the contractor in writing that it has 30 days to complete the balance of the Work. The Contractor shall respond within 7 days stating its intention to complete the work or reasons why the work cannot be completed within the allocated time frame. In the event that the Work is not completed within the stipulated 30-day time frame, the District reserves the right, without limitation to allocate values to the remaining punch list items and withhold up to 150% of the value of that work from the Contractor's final Application for Payment.

1.05 CLOSEOUT REQUIREMENTS

- A. Subsequent to final punch list sign-off and prior to Application for Final Payment, submit all record documents to District that are required by governing or other authorities.
- B. Deliver salvaged materials, extra stock materials, and maintenance supplies to Owner.
- C. Perform onsite training for new mechanical and electrical systems as specified in Section 01 73 00 – Execution.
- D. Complete the testing and balancing requirements and confirm that all systems are functioning properly.
- E. Coordinate necessary service contracts.
- F. Remove all temporary services and contractor property from premises and affected areas restored.
- G. Provide the following Closeout Documents:
 1. Closeout Project Manual (one electronic copy uploaded to E-Builder per school):
 - a. A list of subcontractors with contact information (including emergency phone number), and a summary description of their scope of work.
 - b. A list of manufacturers with phone numbers and addresses of local distributors, service representatives and parts dealers. Include 24-hour service representatives when available.
 - c. Warranties and guarantees from all subcontractors and suppliers including contact information for each warranty and a detailed description of their scope of work.
 - d. The letter from the Contractor stating that the Work is Substantially Complete.
 - e. The Engineer's Substantial Completion Observation Reports and punch lists.
 - f. The signed Substantial Completion Certificate.
 - g. Record of the final punch list work being completed and accepted by Owner, Construction Manager, and Engineers.
 - h. The final Application for Payment.
 - i. Contractor's affidavit of payment of debts and claims.
 - j. Certificate of consent of surety company to final payment.
 - k. Contractor's certificate of completion and release of liens.
 - l. Final permit(s) with all required signatures.
 - m. Temporary Certificate of Occupancy and/or Certificate of Occupancy.
 - n. Special inspector's final report.
 - o. Structural engineer's final sign-off.
 - p. Testing and balancing reports.

- q. Signed transmittal for delivery of salvaged parts, extra stock materials, and maintenance supplies to PPS.
 - r. A summary of trainings completed and participants.
- 2. Record Drawings (one electronic copy per school):
 - a. Contractor shall submit a redline markup in Bluebeam.
- 3. Record Specifications (one electronic copy per school):
 - a. Contractor shall submit a color scan of their fully-updated Record Specifications as defined in Section 01 73 00 – Execution. Redlines in bluebeam are also acceptable.
- 4. Operation and Maintenance Manuals (one electronic copy per school):
 - a. Contractor shall submit O&M manuals as defined in Section 01 73 00 - Execution.
- H. Final Payment Documentation: The final payment for the remaining retained percentages shall not become due until the Contractor submits:
 - 1. An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might in any way be responsible, have been paid or will be paid or otherwise satisfied within thirty (30) days after receipt of final payment from the Owner.
 - 2. Consent of surety to final payment.
 - 3. Certificate of Completion and Release of Liens.
 - 4. All Closeout Documents have been accepted by the Owner.
 - 5. If any third party fails or refuses to provide a release of claim or waiver of lien as required by the Owner, the Contractor shall furnish a bond satisfactory to the Owner to indemnify the Owner from liability.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 77 00

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Oxide inhibiting compound.
- D. Wire pulling lubricant.
- E. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; 2008a (Validated 2013).
- F. NEC 210.4(B) - Multiwire Branch Circuits - Disconnecting Means; National Electrical Code; 2008
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop, material change, and quantity of conductors in conduit.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 00 - Submittals.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE MANUFACTURERS

- A. Cerro Wire LLC: www.cerrowire.com.
- B. Encore Wire Corporation: www.encorewire.com.
- C. American Insulated Wire: www.leviton.com.
- D. Southwire Company: www.southwire.com.
- E. General Cable; www.generalcable.com.
- F. Substitutions: See Section 01 25 00 - Product Options and Substitutions.

2.03 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

- E. Comply with NEMA WC 70.
- F. Comply with FS A-A-59544 where applicable.
- G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- I. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.
- K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.
- L. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
 - 3. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 4. Tinned Copper Conductors: Comply with ASTM B33.
- M. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
- N. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- O. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Isolated Ground, All Systems: Green with yellow stripe.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:

1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid or Stranded.
 - b. Size 8 AWG and Larger: Stranded.
 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN, THHN/THWN-2, or XHHW-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2, THHN/THWN, or THHN/THWN-2.
 - b. Installed Underground: Type XHHW-2, THHN/THWN, or THHN/THWN-2.

2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors or compression connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use compression connectors.
 3. Connectors for Aluminum Conductors: Use compression connectors.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 4. Copper Conductors Size 8 AWG and Larger: Use compression connectors where connectors are required OR for all connections.
 5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 6. Conductors for Control Circuits: Use crimped terminals where connectors are required.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.

- H. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.

2.06 WIRING ACCESSORIES

- A. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 - 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. IlSCO: www.ilsco.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.
- B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 - 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. American Polywater Corporation: www.polywater.com.
 - c. Ideal Industries, Inc: www.idealindustries.com.
 - d. Substitutions: See Section 01 25 00 - Product Options and Substitutions.
- C. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.

2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 ft of location shown.
 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits that originate in the same panelboard are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Install conductors with a minimum of 6 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Identify conductors and cables in accordance with Section 26 05 53.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- R. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1. Contractor shall comply with NEC 210.4(B) by providing a separate neutral conductor for each circuit in a multi-wire branch circuit.
- S. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels. Do not attach cables to slack wires. Plastic cable ties shall be plenum rated in plenum spaces.

3.04 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders.
 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 99 - Health Care Facilities Code; 2015.
- G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system connectors.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Field quality control test reports.
- E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms OR 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested according to IEEE 81 using "point-to-point" methods.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in non-metallic raceway where exposed to physical damage.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal Building or Structure Frame:
 - a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
 - 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
 - b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.
 - c. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated, not more than 30 feet apart, and at each corner of the building/structure.
6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 4 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- G. Service-Supplied System Grounding:
 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. Separately Derived System Grounding:
 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame OR nearest effectively grounded metal water pipe OR common grounding electrode conductor ground riser. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure OR neutral (grounded) bus in first disconnecting means.
 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- J. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
 8. Provide bonding for interior metal air ducts.
 9. Provide bonding for metal building frame where not used as a grounding electrode.
 10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
 11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
 12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.
- K. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
 2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
 3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.
- L. Photovoltaic Systems.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 05 19:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
 - 2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
 - 3. Unless otherwise indicated, use mechanical connectors or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 - 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Burndy: www.burndy.com.
 - b. Harger Lightning & Grounding: www.harger.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy: www.burndy.com.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
 - c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As specified herein.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. Erico International Corporation: www.erico.com.
 - b. Harger Lightning & Grounding: www.harger.com.
 - c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 5/8 inch diameter by 10 feet length, unless otherwise indicated.
 - 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 - 5. Manufacturers:
 - a. Erico International Corporation: www.erico.com.

- b. Galvan Industries, Inc: www.galvanelectrical.com.
- c. Harger Lightning & Grounding: www.harger.com.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.02 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
- E. Identify grounding and bonding system components in accordance with Section 26 05 53.

3.04 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 50 00 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 26 05 34 - Conduit: Additional support and attachment requirements for conduits.
- D. Section 26 05 37 - Boxes: Additional support and attachment requirements for boxes.
- E. Section 26 51 00 - Interior & Exterior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2009.
- F. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2006
- G. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2010
- H. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2009.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- E. Product Data: Provide manufacturer's catalog data for fastening systems.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Comply with applicable building code.
- D. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or Intertek (ETL) as suitable for the purpose indicated, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or stainless steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
- C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.

3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
 1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 3. Channel Material:
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or stainless steel.
 4. Minimum Channel Thickness: 14 gauge.
 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Single Conduit up to 1 inch (27mm) trade size: 1/4 inch diameter.
 - c. Single Conduit larger than 1 inch (27mm) trade size: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - e. Outlet Boxes: 1/4 inch diameter.
 - f. Luminaires: 3/8 inch diameter.
- G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com.

- c. PHP Systems/Design: www.phpsd.com.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Anchors and Fasteners:
- 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Powder-actuated fasteners are permitted only as follows:
 - a. Where approved by Architect.
 - b. Use only threaded studs; do not use pins.
 - 11. Hammer-driven anchors and fasteners are permitted only as follows:
 - a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
 - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: 12 gauge.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 - 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 - 14. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 15. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Hilti, Inc: www.us.hilti.com.
 - b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Obtain permission from Architect before using powder-actuated anchors.
 - 2. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
 - 3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
 - 4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.

5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
 6. Solid Masonry Walls: Use expansion anchors or preset inserts.
 7. Sheet Metal: Use sheet metal screws.
 8. Wood Elements: Use wood screws.
- D. Fastener Types:
1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.
 7. Manufacturers:
 - a. Powers Fasteners, Inc: www.powers.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Formed Steel Channel:
1. Manufacturer: Kindorf, Unistrut, B-Line, or approved.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Steel Spring Clips:
1. Manufacturer: Caddy, Raco, T&B, B-Line.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 2. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 4. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
 5. Manufacturers:
 - a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
 - b. PHP Systems/Design: www.phpsd.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 2. Obtain permission from Architect before drilling or cutting structural members.
- B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

- D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- F. Install products in accordance with manufacturer's instructions.
- G. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- H. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- I. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- J. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- K. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- L. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- M. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- N. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- O. Conduit Support and Attachment: Also comply with Section 26 05 34.
- P. Box Support and Attachment: Also comply with Section 26 05 37.
- Q. Interior Luminaire Support and Attachment: Also comply with Section 26 51 00.
- R. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- S. Secure fasteners according to manufacturer's recommended torque settings.
- T. Remove temporary supports.
- U. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 05 29

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. Electrical metallic tubing (EMT).
- D. Conduit fittings.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 37 - Boxes.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2701 - Group Metering Equipment: Additional requirements for electrical service conduits.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- N. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

- Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- S. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.
- C. For projects with Post Tension (PT) slab construction, submit dimensioned plan showing all conduit sleeves & block out locations to Architect for review.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings:
 - 1. Include proposed locations of roof penetrations and proposed methods for sealing.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

201 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications.
- C. Underground:
 - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), or rigid PVC conduit.
 - 3. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit or intermediate metal conduit (IMC) where emerging from underground.

4. Where rigid polyvinyl (PVC) conduit is provided, use galvanized steel rigid metal conduit elbows at all stub up locations.
 5. 1.5 Inches Diameter and Smaller: For total conduit lengths between pull points over 100 ft., use rigid steel elbows.
 6. Where steel conduit is installed in direct contact with earth use where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience to provide supplementary corrosion protection.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
 - E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
 - F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
 - G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - H. Exposed, Interior: Install intermediate metal conduit (IMC) where installed below the bottom chord of trusses, use EMT conduit where installed above cord of trusses.
 - I. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
 - J. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
 - K. Corrosive Locations Above Ground: Use rigid PVC conduit.
 1. Corrosive locations include, but are not limited to:
 - a. Cooling towers.
 - b. Swimming pool equipment rooms.
 - L. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - M. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 1. Maximum Length: 6 feet.
 - N. Connections to Vibrating Equipment:
 1. Dry Locations: Use flexible metal conduit.
 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 3. Maximum Length: 6 feet unless otherwise indicated.
 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
 - O. Insulate conduits entering coolers at the first 48".

202 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Electrical Service Conduits/
- C. Communications Systems Conduits.
- D. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
- E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

- F. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or Intertek (ETL) as suitable for the purpose indicated.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 1/2-inch (16 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Control Circuits: 1/2-inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 1/2-inch (16 mm) trade size.
 - 5. Underground, Interior: 3/4-inch (21 mm) trade size.
 - 6. Underground, Exterior: 3/4-inch (21 mm) trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

203 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

204 INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

205 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. Allied Tube & Conduit: www.alliedeg.com.
 2. Republic Conduit: www.republic-conduit.com.
 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use set-screw type except when embedded in concrete. Use concrete tight compression (gland) type in concrete.
 - a. Do not use indenter type connectors and couplings.
 5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

206 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 1. Cantex Inc: www.cantexinc.com.
 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
 3. JM Eagle: www.jmeagle.com.
 4. Allied Tube and Conduit: www.alliedtube.com.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
- D. Elbows:
 1. Use only factory formed Schedule 40 elbows. Field bends are not acceptable.
 2. 1.5 Inches Diameter and Smaller: For total conduit lengths between pull points over 100 ft., use rigid steel elbows. For shorter overall lengths, rigid steel or Schedule 40 PVC may be used.
 3. 2 Inches Diameter and Larger: For total conduit lengths between pull points over 100 ft., use long sweep rigid steel or fiberglass elbows. For shorter overall lengths, rigid steel, fiberglass, or Schedule 40 PVC elbows may be used.

207 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 10 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Paint all exposed conduits in corridors, office, classrooms, or areas of student access.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. PVC conduit not allowed above grade.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- F. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. MDF/IDF rooms.
 - 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than the equivalent of three 90 degree bends between pull points.
 - 9. Arrange conduit to provide no more than 150 feet between pull points.
 - 10. Route conduits above water and drain piping where possible.
 - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 - 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces.
 - 14. Group parallel conduits in the same area together on a common rack.
- G. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where specifically approved).
 9. Use of spring steel conduit clips for support of conduits is permitted only as follows:
 - a. Support of electrical metallic tubing (EMT) up to 1 inch (27 mm) trade size concealed above accessible ceilings and within hollow stud walls.
 10. Use of wire for support of conduits is not permitted.
 11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- H. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- I. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
 7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. Provide metal escutcheon plates for conduit penetrations exposed to public view.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- J. Underground Installation:
1. Provide trenching and backfilling .
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
 3. Provide underground warning tape in accordance with Section 26 05 53 along entire conduit length for service entrance where not concrete-encased.

- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings or approved flexible connections to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 3. Where conduits are subject to earth movement by settlement or frost.
- L. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 - 1. Where conduits pass from outdoors into conditioned interior spaces.
 - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 - 3. Where conduits penetrate coolers or freezers.
- M. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- N. Provide grounding and bonding in accordance with Section 26 05 26.
- O. Identify conduits in accordance with Section 26 05 53.
- P. Do not cross conduits in slab.
- Q. Cut conduit square using saw or pipecutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. 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.
- T. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- U. Conduit runs shall not exceed 100 feet without an accessible pull box installed in line.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 05 34

SECTION 26 05 37

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes for hazardous (classified) locations.
- D. Floor boxes.
- E. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 34 - Conduit:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 01 - Wall Mounted Group Metering Equipment: Metering transformer cabinets.
- G. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; 2013.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.
- C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Electrical boxes shall be sized according to NEC requirements unless otherwise noted in the contract documents.
- D. Maintain integrity of insulation materials where flush boxes are installed in insulated spaces.
- E. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- F. PVC boxes are not approved.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or Intertek (ETL) as suitable for the purpose indicated.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

- B. Outlet and Device Boxes Up to 100 cubic inches, Including those used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
 5. Use suitable concrete type boxes where flush-mounted in concrete.
 6. Use suitable masonry type boxes where flush-mounted in masonry walls.
 7. Use raised covers suitable for the type of wall construction and device configuration where required.
 8. Use shallow boxes where required by the type of wall construction.
 9. Do not use "through-wall" boxes designed for access from both sides of wall.
 10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 14. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: Comply with Section 27 10 00.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
 15. Wall Plates: Comply with Section 26 27 26.
 16. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-bell.com.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-raco.com.
 - d. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com.
 - f. Appleton Electric.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable (where applicable).
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Electrical Outlet Box Pad:
 1. Electrical outlet box pads shall be applied where called out on the drawings or specifications. Its function is to seal box openings, increase mass, and provide damping to reduce air-transmitted sound through party walls. It shall consist of polybutene-butyl and inert fillers. Material shall provide good adhesion to metal and plastic. Pads shall be applied to the backs of installed electrical boxes, molded to box, and folded around conduit cable entering the box. Pads shall not be used in areas subject to temperatures above 200 degrees F.
 2. The following are acceptable, subject to the above:
 - a. Lowry's outlet box pads from Harry A. Lowry & Associates, Inc., Sun Valley, California, (800) 225-8231.
 - b. SpecSeal firestop putty pads (fire-rated) from Specified Technologies, Incorporated, Somerville, New Jersey, (800) 992-1180.
 - c. Or approved equal.
- E. In-Ground Cast Metal Box: NEMA 250, Type 6, flanged, recessed cover box for flush mounting:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify exact location of floor boxes with Architect.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 1. Locate boxes to be accessible. Provide access panels as required where approved by the Architect.
 - a. Coordinate exact location of infloor boxes with Architect.
 - b. Adjust box locations up to 10 feet if required to accommodate intended purpose, at no additional cost to the owner.
 2. Unless dimensioned, box locations indicated are approximate.
 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply as indicated on drawings.
 - b. Communications Systems Outlets: Comply as indicated on drawings.
 4. Locate boxes so that wall plates do not span different building finishes.
 5. Locate boxes so that wall plates do not cross masonry joints.

6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
8. Fire-Resistance-Rated Walls: Install flush-mounted boxes such that the required fire-resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 34.
10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.
- R. Identify boxes in accordance with Section 26 05 53.

1. Adjust box locations up to 10 feet if required to accommodate intended purpose, at no additional cost to Owner.
- S. Orient boxes to accommodate wiring device orientation as specified in Section 26 27 26.
- T. Maintain headroom and present neat mechanical appearance.
- U. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- V. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- W. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- B. Clean exposed surfaces and restore finish.

3.04 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box with products furnished under other sections of these specifications.
- B. Coordinate locations and sizes of required access doors.
- 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 with architectural drawings.

END OF SECTION 26 05 37

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain whose designations are changed as part of the new work.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device. Identify spares.
 - b. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source.

- 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
- 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces. Identify load type, circuit number, breaker size and number of poles, and circuit load in volt-amps.
- 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares.
- c. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source.
 - 4) Identify load(s) served.
- d. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source.
 - 3) Identify load(s) served.
2. Emergency System Equipment:
 - a. Use identification nameplate to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate or identification label at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate or identification label to identify emergency operating instructions for emergency system equipment.
3. Use voltage marker or identification label to identify highest voltage present for each piece of electrical equipment with voltage 480 V or higher.
4. Use identification nameplate or identification label to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.
5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 5 by 7 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as indicated on the drawings:
 - 1) Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - 2) Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - 3) Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
 - 4) Include the following information:
 - (a) Arc flash protection boundary.
 - (b) Incident energy.
 - (c) Hazard/risk category.
 - (d) PPE (personnel protective equipment) requirements.
 - (e) Nominal voltage.
 - (f) Shock hazard condition.

- (g) Limited approach boundary.
- (h) Restricted approach boundary.
- (i) Prohibited approach boundary.
- (j) Equipment identification.
- (k) Date calculations were performed.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.

480/277V, 3 Phase, 4 Wire System

Phase A - Brown
 Phase B - Orange
 Phase C - Yellow
 Neutral - Gray
 Ground - Green

Less than 250 Volts Between Phases:

Phase A - Black
 Phase B - Red
 Phase C - Blue
 Neutral - White
 Ground - Green

2. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
3. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
4. Use underground warning tape to identify direct buried cables.

D. Identification for Boxes:

1. Use handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, provide identification on inside face of cover.

E. Identification for Devices:

1. Use identification label to identify serving branch circuit for all receptacles.
2. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com.
 - b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
 - c. Seton Identification Products: www.seton.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

- a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
- 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
- 5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
- 6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com.
 - b. Brother International Corporation: www.brother-usa.com.
 - c. Panduit Corp: www.panduit.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
 - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com.
 - 2. HellermannTyton: www.hellermannntyton.com.
 - 3. Panduit Corp: www.panduit.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
 - 1. Do not use self-adhesive type markers.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
 - 1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door or enclosure front.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.

- 8. Boxes: Outside face of cover unless otherwise noted.
- 9. Conductors and Cables: Legible from the point of access.
- 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws, rivets, self-adhesive backing, or epoxy cement and to interior surfaces using self-adhesive backing or epoxy cement.
 - 1. Do not use adhesives on exterior surfaces except where substrate can not be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Secure rigid signs using stainless steel screws.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 05 53

SECTION 26 22 00
LOW-VOLTAGE
TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shielded transformers.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- D. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- F. NEMA TP 1 - Guide for Determining Energy Efficiency for Distribution Transformers; National Electrical Manufacturers Association; 2002.
- G. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers; National Electrical Manufacturers Association; 2005.
- H. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency; National Electrical Manufacturers Association; 2000.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- L. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
 - 1. Vibration Isolators: Include attachment method and rated load and deflection.
 - 2. Shielded Transformers: Include shielding method and noise attenuation performance.
 - 3. Small Power Centers: Include panelboard bus ampacity, integrated short circuit ampere rating, and circuit breaker sizes and ampere ratings.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
 - 1. Small Power Centers: Include panel arrangements.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Maintenance Data: Include recommended maintenance procedures and intervals.
- H. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 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 transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. General Electric Company: www.geindustrial.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens.
- E. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 SHIELDED TRANSFORMERS

- A. Description: Self-cooled, two winding, shielded isolation transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: As indicated on Drawings.
- C. Secondary Voltage: As indicated on Drawings.
- D. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 185 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.

4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Standard efficiency complying with NEMA TP 1.
 1. Test efficiency according to NEMA TP 2.
 2. Label transformer according to NEMA TP 3.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20.
- I. Winding Shield: Electrostatic, with separate insulated grounding connection.
- J. Mounting Provisions:
 1. Less than 15 kVA: Suitable for wall mounting.
 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 3. Larger than 75 kVA: Suitable for floor mounting.
- K. Transformer Enclosure: Comply with NEMA ST 20.
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 2.
 - b. Outdoor locations: Type 3R.
 2. Construction: Heavy gage steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 4. Provide lifting eyes or brackets.
- L. Accessories:
 1. Mounting Brackets: Provide manufacturer's standard brackets.
 2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.
 3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.
- M. All lugs shall be field replaceable compression type.

2.03 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.
- B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install transformers in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 05 34, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Set transformers plumb and level.
- G. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- H. Mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed.
- I. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.
- J. Mount trapeze-mounted transformers as indicated.
- K. Provide seismic restraints.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
- M. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- N. Where not factory-installed, install lugs sized as required for termination of conductors as shown on the drawings.
- O. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
- P. Identify transformers in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.
 - 1. 167 kVA single phase, 500 kVA three phase and smaller:
 - a. Perform turns ratio tests at all tap positions.
 - 2. Larger than 167 kVA single phase and 500 kVA three phase:
 - a. Verify that control and alarm settings on temperature indicators are as specified.
 - b. Perform excitation-current tests on each phase.
 - c. Measure the resistance of each winding at each tap connection.
 - d. Perform an applied voltage test on all high- and low-voltage windings-to-ground.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 22 00

SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- D. NEMA PB 1 - Panelboards; 2011.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- F. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 67 - Panelboards; Current Edition, Including All Revisions.
- K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- L. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Panelboard Keys: One for each panelboard installed.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. 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.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; Square D Products: www.schneider-electric.us.
- B. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02 ALL PANELBOARDS

- A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
- C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location.
 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70, acceptable only where specifically indicated, or not acceptable.
 3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. All panelboards shall have door-in-door type front covers
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide 200 percent rated neutral bus and lugs where oversized neutral conductors are provided.
 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Provide separate isolated/insulated ground bus where indicated.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide removable end walls for NEMA Type 1 enclosures.
 - d. Provide painted steel boxes for surface-mounted panelboards, finish to match fronts.
 3. Fronts:
 - a. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- L. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- M. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
 2. Main breaker.
 3. Double lugs.

2.03 OVERCURRENT PROTECTIVE DEVICES

2.04 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the top of panelboard is 6 feet 6 inches above the floor or working platform. Install panelboards taller than 6 feet with bottom no more than 4 inches above the floor.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- I. Install all field-installed branch devices, components, and accessories.
- J. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- K. Set field-adjustable circuit breaker tripping function settings as required.
- L. Set field-adjustable ground fault protection pickup and time delay settings as required.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Communications equipment circuits.
 - 4. Intrusion detection and access control system circuits.
 - 5. Video surveillance system circuits.
- O. Identify panelboards in accordance with Section 26 05 53.
- P. Provide computer-generated circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
- Q. Provide minimum four (4) spares and four (4) spaces per 42-circuit panelboard.

3.03 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 800 amperes. Tests listed as optional are not required.
 - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 2. Test functions of the trip unit by means of secondary injection.
- D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 17
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 34 - Conduit.
- C. Section 26 05 37 - Boxes.
- D. Section 26 27 26 - Wiring Devices.
- E. Section 26 28 16.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
 - 3. Conduit, wire and circuit breaker sizes for mechanical equipment and equipment furnished under other Divisions are based on the equipment ratings of one manufacturer. The equipment actually furnished may have different electrical characteristics. Conduit, wire, and circuit breakers shall not be ordered or installed until exact electrical requirements are obtained. Responsibility for this coordination shall rest with the Contractor.
 - 4. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering devices and coverplates.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Conform to NEMA WD 1.
 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Enclosed Switches: As specified in Section 26 2818.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 34.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 37.

2.02 EQUIPMENT CONNECTIONS

- A. As indicated on Drawings

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. All equipment is to be grounded with equipment grounding conductor per NEC requirements.
- K. Provide conduit for low voltage control cables/conductors.

END OF SECTION 26 27 17

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.
- D. Occupancy sensors.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 33.23 - Surface Raceways: Surface raceway systems, including multioutlet assemblies.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 27 17 - Equipment Wiring: Cords and plugs for equipment.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 60 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
- C. Samples: One for each type and color of device and wall plate specified, if requested.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFI Receptacles: Include information on status indicators and testing procedures and intervals.
- G. Project Record Documents: Record actual installed locations of wiring devices.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 - 3. Extra Keys for Locking Switches: Five of each type.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

201 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com. Part numbers indicated are Hubbell; equals by other manufacturers are acceptable, unless otherwise noted.
- B. Leviton Manufacturing Company, Inc.: www.leviton.com.
- C. Lutron Electronics Company, Inc.: www.lutron.com.
- D. Pass & Seymour, a brand of Legrand North America, Inc.: www.legrand.us
- E. Cooper Wiring Devices: www.cooperwiringdevices.com.
- F. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Source Limitations: Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single supplier.

202 APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for all receptacles installed in dwelling units.

- E. Provide GFI protection for all receptacles installed within 6 feet of sinks.
- F. Provide GFI protection for all receptacles installed to serve the countertop surfaces in residential kitchens and all 15A and 20A, 125V receptacles in non-dwelling type kitchens.
- G. Provide GFI protection for all receptacles serving electric drinking fountains.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.
- I. For flush floor service fittings, use tile rings for installations in tile floors.
- J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

203 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Finishes:
 - 1. All Wiring Devices: All wall plates shall be 302 Stainless Steel.
 - 2. Wiring Devices Installed in Finished Spaces; wiring device colors shall be:
 - 1. Emergency – Red.
 - 2. Standby – Blue.
 - 3. Normal – Grey.

204 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com. Part numbers indicated are Hubbell; equals by other manufacturers are acceptable, unless otherwise noted.
 - 2. Leviton Manufacturing Company, Inc.: www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.: www.legrand.us
 - 4. Cooper Wiring Devices: www.cooperwiringdevices.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; switch type as indicated on the drawings.

205 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc.: www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc.: www.legrand.us
 - 4. Cooper Wiring Devices: www.cooperwiringdevices.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles in Commercial Areas: Commercial specification grade, 20A, 125V, NEMA 5-20R and/or 15A, 125V, NEMA 5-15R; type as indicated on the drawings.
 - 2. Standard Convenience Receptacles in Residential Areas: Residential grade, 20A, 125V, NEMA 5-20R and/or 15A, 125V, NEMA 5-15R; type as indicated on the drawings.
 - 3. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R and/or 15A, 125V, NEMA 5-15R, , listed and labeled as weather

resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; type as indicated on the drawings.

4. Tamper Resistant Convenience Receptacles: Residential grade, 20A, 125V, NEMA 5-20R and/or 15A, 125V, NEMA 5-15R, , listed and labeled as tamper resistant type; type as indicated on the drawings.
5. Tamper Resistant and Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R and/or 15A, 125V, NEMA 5-15R, , listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; type as indicated on the drawings.

206 WALL PLATES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell-wiring.com.
 2. Leviton Manufacturing Company, Inc.: www.leviton.com.
 3. Pass & Seymour, a brand of Legrand North America, Inc.: www.legrand.us
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Wall Plates: Shall be #302 Stainless Steel.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
 4. Provide screwless wall plates with concealed mounting hardware for all receptacles.

207 OCCUPANCY SENSORS

- A. The drawings show approximate locations of detectors and are diagrammatic only. Exact locations of detectors are to be field verified with the factory representative prior to mounting.
- B. Provide power pack as required for low voltage occupancy sensors. Wattstopper BZ-150 Series.
- C. 30A, 120V outlet for MDF UPS shall be L5-30 NEMA type.

PART 3 EXECUTION

301 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that openings in access floor are in proper locations.
- H. Verify that conditions are satisfactory for installation prior to starting work.

302 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Install wiring devices in accordance with manufacturer's instructions.
- C. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal or inserting conductor screw-actuated in binding clamp and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- D. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 4000.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 27 26

SECTION 26 28 26
ENCLOSED TRANSFER SWITCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Automatic transfer switch.

1.02 RELATED SECTIONS

- A. Section 26 32 13 - Packaged Propane Vapor Generator: Testing requirements.

1.03 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- E. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. 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.
- 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.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.
- B. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions when engine generator is running.
- C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience, and with service facilities within 50 miles of Project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by UL as suitable for purpose specified and indicated.

1.08 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.

1.09 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.11 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 01 78 23.
- B. Provide two of each special tool required for maintenance.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. ONAN.
- B. Pacific Detroit Diesel.
- C. CATERPILLAR.
- D. ASCO.
- E. Katolight.

2.02 AUTOMATIC TRANSFER SWITCH

- A. Description: NEMA ICS 2, automatic transfer switch.
- B. Configuration: Electrically operated, mechanically held transfer switch.
- C. Open Transition.

2.03 SERVICE CONDITIONS

- A. Service Conditions: NEMA ICS 1.
- B. Temperature: 90 degrees F.
- C. Altitude: 1000 feet.

2.04 RATINGS

- A. Voltage: As noted on drawings.
- B. Switched Poles: 3.
- C. Load Inrush Rating: Combination.
- D. Continuous Rating: As noted on drawings.
- E. Interrupting Capacity: 100 percent of continuous rating.
- F. Withstand Current Rating: Shall meet or exceed available 3 phase fault current.

2.05 PRODUCT OPTIONS AND FEATURES

- A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.
- B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
- C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.
- D. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
- E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent from rated nominal value.
- F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent from rated nominal value.

2.06 AUTOMATIC SEQUENCE OF OPERATION

- A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

- B. Time Delay To Start Alternate Source Engine Generator: 0 to 30 seconds, adjustable.
- C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
- D. Time Delay Before Transfer to Alternate Power Source: 0 to 30 seconds, adjustable.
- E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
- F. Time Delay Before Transfer to Normal Power: 0 to 30 seconds, adjustable; bypass time delay in event of alternate source failure.
- G. Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, of unloaded operation.
- H. Engine Exerciser: Start engine every 30 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.
- I. Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

2.07 ENCLOSURE

- A. Enclosure: ICS 6, Type 1.
- B. Finish: Manufacturer's standard enamel.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 26 28 26

SECTION 26 32 13
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Engine mount radiator.
- C. Exhaust silencer and fittings.
- D. Fuel fittings and day tank.
- E. Fuel tank.
- F. Remote control panel.
- G. Battery and charger.
- H. Weatherproof enclosure.
- I. Generator Pad.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- C. Section 22 0719 - Plumbing Piping Insulation.
- D. Section 23 11 13 - Facility Fuel-Oil Piping:
 - 1. Diesel fuel piping.
- E. Section 23 31 00 - HVAC Ducts and Casings.
- F. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- G. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- I. Section 26 36 00 - Transfer Switches.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- C. NEMA MG 1 - Motors and Generators; 2017.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- E. NFPA 30 - Flammable and Combustible Liquids Code; 2018.
- F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2015.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 99 - Health Care Facilities Code; 2015.
- I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2013.
- J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
 - 1. Certified prototype tests.
 - 2. Torsional vibration compatibility certification.
 - 3. NFPA 110 compliance certification.
 - 4. Certified rated load test at rated power factor.
- C. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- D. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, remote radiator, remote fuel fill station, and weather proof enclosures.
- E. Test Reports: Indicate results of performance testing.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate procedures and findings.
- I. Operation Data: Include instructions for normal operation.
- J. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.
- K. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Filter Elements: Two of each type, including fuel, oil and air.
 - 2. Tools: One set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
 - 3. NFPA 101.

4. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
5. NFPA 30 (Flammable and Combustible Liquids Code).
 - a. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Products: Listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience with service facilities within 50 miles of Project.
- D. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years experience.
- E. Products: Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept unit on site on skids. Inspect for damage.
- B. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

PART 2 PRODUCTS

201 MANUFACTURERS

- A. Caterpillar Inc.: www.caterpillar.com.
- B. Cummins : www.cummins.com.
- C. Kohler: www.kohler.com.

202 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. System Description:
 1. Application: Emergency/standby.
 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
- C. Packaged Engine Generator Set:
 1. Type: Diesel (compression ignition).
 2. Power Rating: See electrical drawings.
 3. Voltage: See electrical drawings.
- D. Generator Set General Requirements:
 1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
 2. Factory-assembled, with components mounted on suitable base.
 3. List and label engine generator assembly as complying with UL 2200.
 4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
 5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
- E. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- F. Starting and Load Acceptance Requirements:
 1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.

2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
 4. Maximum Load Step: Supports 100 percent of rated load in one step.
- G. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.
- H. System Capacity: As indicated on drawings at elevation of 500 feet above sea level, standby rating using engine-mounted radiator.

203 ENGINE AND ENGINE ACCESSORY EQUIPMENT

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
 2. Fuel Storage: Sub-base fuel tank.
 3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
 4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 5. Sub-Base Fuel Tank:
 - a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
 - b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
 - c. Features:
 - 1) Direct reading fuel level gauge.
 - 2) Normal atmospheric vent.
 - 3) Emergency pressure relief vent.
 - 4) Fuel fill opening with lockable cap.
 - 5) Dedicated electrical conduit stub-up area.
- C. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
 2. Battery(s):
 - a. Battery Type: Lead-acid.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
 4. Battery Charger:

- a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Recognized as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
 - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
 - f. Provide alarm output contacts as necessary for alarm indications.
- D. Engine Speed Control System (Governor):
- 1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 - 2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- E. Engine Lubrication System:
- 1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
- F. Engine Cooling System:
- 1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 - 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
- G. Engine Air Intake and Exhaust System:
- 1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 - 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
- H. Governor: Isochronous type to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.
- I. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.
- J. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

204 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
 - 1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 - 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 - 3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.
- G. Rating: kW as indicated on drawings, at 0.8 power factor, voltage as indicated on drawings, 60 Hz at 1800 rpm.

205 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
 - 1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 - 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
 - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
 - f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
 - 3. Generator Set Status Indications:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).
 - e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure.
 - l. Engine coolant temperature.
 - m. Engine run time.
 - n. Generator powering load (position signal from transfer switch).
 - 4. Generator Set Protection and Warning/Shutdown Indications:
 - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (shutdown).
 - 6) Overspeed (shutdown).
 - 7) Low fuel level (warning).
 - 8) Low coolant level (warning/shutdown).
 - 9) Generator control not in automatic mode (warning).
 - 10) High battery voltage (warning).
 - 11) Low cranking voltage (warning).
 - 12) Low battery voltage (warning).
 - 13) Battery charger failure (warning).

- b. In addition to NFPA 110 requirements, provide the following protections/indications:
 - 1) High AC voltage (shutdown).
 - 2) Low AC voltage (shutdown).
 - 3) High frequency (shutdown).
 - 4) Low frequency (shutdown).
 - 5) Overcurrent (shutdown).
 - c. Provide contacts for local and remote common alarm.
 - d. Provide lamp test function that illuminates all indicator lamps.
 - 5. Other Control Panel Features:
 - a. Event log.

206 ACCESSORIES

- A. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.
- B. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.
- C. Line Circuit Breaker: Molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70; UL listed. Include battery-voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements. Coordinate with electrical system per NEC 700.28 and 701.27.
- D. Remote Annunciator Panel: Flush mounted panel with painted finish. Provide alarm horn, and indicators and alarms as follows:
 - 1. High battery voltage (alarm).
 - 2. Low battery voltage (alarm).
 - 3. Low fuel (alarm).
 - 4. System ready.
 - 5. Anticipatory-high water temperature.
 - 6. Anticipatory-low oil pressure.
 - 7. Low coolant temperature.
 - 8. Switch in off position (alarm).
 - 9. Overcrank (alarm).
 - 10. Emergency stop (alarm).
 - 11. High water temperature (alarm).
 - 12. Overspeed (alarm).
 - 13. Low oil pressure (alarm).
 - 14. Line power available.
 - 15. Generator power available.
 - 16. Lamp test and horn silence switch.
- E. Weather-Protective Enclosure: Sound attenuated, reinforced steel housing allowing access to control panel and service points, with lockable doors and panels. Include fixed louvers, battery rack, and silencer.
- F. Provide fuel tank under generator set to accommodate 24 hours of engine run time at 100% output.

PART 3 EXECUTION

301 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install products in accordance with manufacturer's instructions.
- C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.

- E. Unless otherwise indicated, mount generator set on properly sized 6 inch high concrete pad constructed in accordance with Section 03 30 00. Provide suitable vibration isolators, where not factory installed.
- F. Provide required support and attachment in accordance with Section 26 05 29.
- G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- H. Provide diesel fuel piping and venting in accordance with Section 23 21 13, where not factory installed.
- I. Provide engine exhaust piping in accordance with Section 23 51 00, where not factory installed.
 - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
 - 2. Do not exceed manufacturer's maximum back pressure requirements.
- J. Provide grounding and bonding in accordance with Section 26 05 26.
- K. Identify system wiring and components in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- E. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- F. Prepare and start system in accordance with manufacturer's instructions.
- G. Perform acceptance test in accordance with NFPA 110.
- H. Provide field emissions testing where necessary for certification.
- I. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
- J. Provide the services of manufacturer's representative to prepare and start system.
- K. Provide full load test utilizing portable test bank, if required, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal. Provide fuel required for testing.
- L. Record in 20 minute intervals during four hour test:
 - 1. Kilowatts.
 - 2. Amperes.
 - 3. Voltage.
 - 4. Coolant temperature.
 - 5. Room temperature.
 - 6. Frequency.
 - 7. Oil pressure.

3.03 ADJUSTING

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

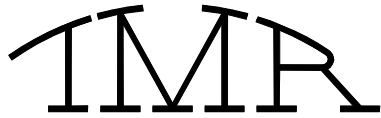
3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation to Owner's operating personnel:
 - 1. Describe loads connected to emergency and standby system and restrictions for future load additions.
 - 2. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency and standby power.
- B. Fill fuel tank to full level at Substantial Completion.

3.06 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of engine generator for one year from Date of Substantial Completion.

END OF SECTION 26 32 13



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STRUCTURAL CALCULATIONS

PROJECT: BEAVERTON SD – FIR GROVE ELEM. GENERATOR PAD

LOCATION: 6300 SW WILSON AVE.
BEAVERTON, OR

CLIENT: MKE & ASSOCIATES, INC.

DATE: NOVEMBER 18, 2020

PROJECT NUMBER: 21460

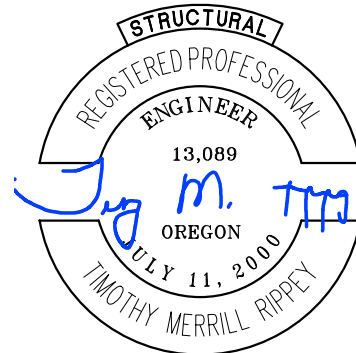


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EXPIRES: 12-31-22

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CALCULATIONS	C1 – C5

DESCRIPTION:

THIS DESIGN PACKAGE INCLUDES SKETCHES AND CALCULATIONS FOR ANCHORAGE OF ONE (1) GENERATOR UNIT AT THE ADDRESS NOTED ABOVE.

GENERAL STRUCTURAL NOTES

CODE REQUIREMENTS:

CONFORM TO THE 2018 INTERNATIONAL BUILDING CODE AS AMENDED BY THE 2019 OREGON STRUCTURAL SPECIALTY CODE, REFERENCED HEREFTER AS IBC.

DESIGN CRITERIA:

DESIGN WAS BASED ON THE STRENGTH AND DEFLECTION CRITERIA OF THE IBC. IN ADDITION TO THE DEAD LOADS, THE FOLLOWING LOADS WERE USED FOR DESIGN:

GENERATOR UNIT = 2520 LBS

SEISMIC IMPORTANCE FACTOR I_e : 1.25

SITE CLASS: D (ASSUMED)

SDS = 0.698

BASIC WIND SPEED (3-SEC GUST, ULTIMATE): 103 MPH

WIND EXPOSURE: B

BUILDING RISK CATEGORY: III

TEMPORARY CONDITIONS:

THE CONTRACTOR SHALL BE RESPONSIBLE FOR STRUCTURAL STABILITY OF THE NEW AND EXISTING STRUCTURES AND WALLS DURING CONSTRUCTION. THE STRUCTURE SHOWN ON THE DRAWINGS HAS BEEN DESIGNED FOR STABILITY UNDER THE FINAL CONFIGURATION ONLY.

EARTHWORK:

MAINTAIN THE EXCAVATION FREE FROM GROUND WATER FOR THE TIME REQUIRED TO COMPLETE THE WORK IN A PROPER WORKMANLIKE MANNER. REMOVE LOOSE OR DISTURBED SOIL FROM THE BOTTOMS OF EXCAVATION. FOOTINGS SHALL BEAR ON UNDISTURBED NATIVE SOIL OR ENGINEERED STRUCTURAL FILL.

WHERE COMPACTED AREAS ARE DISTURBED BY CONSTRUCTION OPERATIONS OR ADVERSE WEATHER, OVER EXCAVATE AND BACKFILL WITH 3/4" MINUS CRUSHED ROCK COMPACTED TO MINIMUM OF 95% OF THE DRY DENSITY AS MEASURED BY AASHTO T180. AT DISTURBED AREAS WITHIN 3'-0" OF BUILDING FOUNDATIONS COMPACT TO MINIMUM 95% OF THE DRY DENSITY AS MEASURED BY AASHTO T180.

CAST-IN-PLACE CONCRETE:

MIX DESIGN: PREPARE DESIGN MIXES FOR EACH TYPE OF CONCRETE. PROPORTION MIXES BY EITHER LABORATORY TRIAL BATCH OR FIELD EXPERIENCE METHODS, USING MATERIALS TO BE EMPLOYED ON THE WORK FOR EACH CLASS OF CONCRETE REQUIRED. FURNISH CERTIFIED REPORTS OF EACH PROPOSED MIX FOR EACH TYPE OF WORK OF THIS SECTION. THE CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGNS, ALONG WITH TEST DATA AS REQUIRED, A MINIMUM OF TWO WEEKS PRIOR TO PLACING CONCRETE.

ADMIXTURES: AIR ENTRAINING AGENT IN ACCORDANCE WITH ASTM C260 AND WATER-REDUCING ADMIXTURE CONFORMING TO ASTM 494, USED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS, MAY BE INCORPORATED IN CONCRETE DESIGN MIXES. AN AIR-ENTRAINING AGENT CONFORMING TO ASTM C260 SHALL BE USED IN CONCRETE MIXES FOR EXTERIOR HORIZONTAL SURFACES EXPOSED TO WEATHER. THE AMOUNT OF ENTRAINED AIR SHALL BE 5% - 7% BY VOLUME. FLY ASH SHALL CONFORM TO ASTM C 618 AND SHALL BE LIMITED TO A 15% MAXIMUM BY CEMENT WEIGHT.

CONCRETE WORK SHALL CONFORM TO ACI 301. CONCRETE STRENGTHS SHALL BE VERIFIED BY STANDARD 28-DAY CYLINDER TESTS PER ASTM C39, AND SHALL BE AS FOLLOWS:

SLABS: f'_c =4,000 PSI AT 28 DAYS. (MINIMUM CEMENT CONTENT = 517 LBS)

ABSOLUTE WATER/CEMENT RATIO BY WEIGHT:

f'_c = 4000 PSI (0.50 NON-AIR ENTRAINED, 0.45 AIR ENTRAINED)

HOT AND COLD WEATHER REQUIREMENTS FOR CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF ACI 318.

SLEEVES, OPENINGS, CONDUIT, AND OTHER EMBEDDED ITEMS NOT SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE

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Phone: (503) 443-3900

By: KMJ Date: _____
FIR GROVE ELEMENTARY SCHOOL Chk By: _____ Date: _____
GENERATOR ANCHORAGE Job #: 21460
Sheet: N1 Of: _____

APPROVED BY THE STRUCTURAL ENGINEER BEFORE POURING. CONDUITS EMBEDDED IN SLABS SHALL NOT BE LARGER THAN ONE THIRD OF THE THICKNESS OF THE SLAB AND SHALL NOT BE SPACED CLOSER THAN THREE DIAMETERS ON CENTER. PROVIDE 3/4" CHAMFERS ON ALL EXPOSED CONCRETE EDGES UNLESS NOTED OTHERWISE.

CONCRETE REINFORCING STEEL:

REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60 FOR DEFORMED BARS, UNLESS OTHERWISE NOTED. REINFORCING STEEL TO BE WELDED SHALL CONFORM TO ASTM A706. REINFORCING STEEL TO BE HOT DIP GALVANIZED SHALL CONFORM TO ASTM 767. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A82 AND A185.

REINFORCING STEEL SHALL BE DETAILED IN ACCORDANCE WITH ACI 315 LATEST EDITION ("DETAILS AND DETAILING CONCRETE REINFORCEMENT").

UNLESS NOTED OTHERWISE ON THE DRAWINGS LAP SPLICE LENGTHS SHALL BE 50 BAR DIAMETERS

REINFORCING STEEL SHALL HAVE PROTECTION AS FOLLOWS:

CONDITION:	MINIMUM COVER:
CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH:	3"

CONCRETE EXPOSED TO EARTH AND WEATHER:	
NO.6 THROUGH NO.18 BARS	2"

CONCRETE ACCESSORIES:

CONCRETE EPOXY/ADHESIVE ANCHORS SHALL BE INSTALLED WITH "HILTI HIT-RE 500 V3" (OR ENGINEER APPROVED EQUIVALENT) INSTALLED PER MANUFACTURER'S GUIDELINES AND CURRENT ESR REPORT, AND SHALL MEET THE FOLLOWING CRITERIA:

- A. ADHESIVE ANCHORS SHALL BE INSTALLED BY QUALIFIED PERSONNEL TRAINED TO INSTALL ADHESIVE ANCHORS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND WITH STRICT ADHERENCE TO THE PROVISIONS WITHIN THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS.
- B. AT THE TIME OF ANCHOR INSTALLATION, IN ACCORDANCE WITH ACI 318-11 SECTION D.2.2, ADHESIVE ANCHORS SHALL BE INSTALLED IN CONCRETE HAVING A MINIMUM AGE OF 21 DAYS.

MECHANICAL:

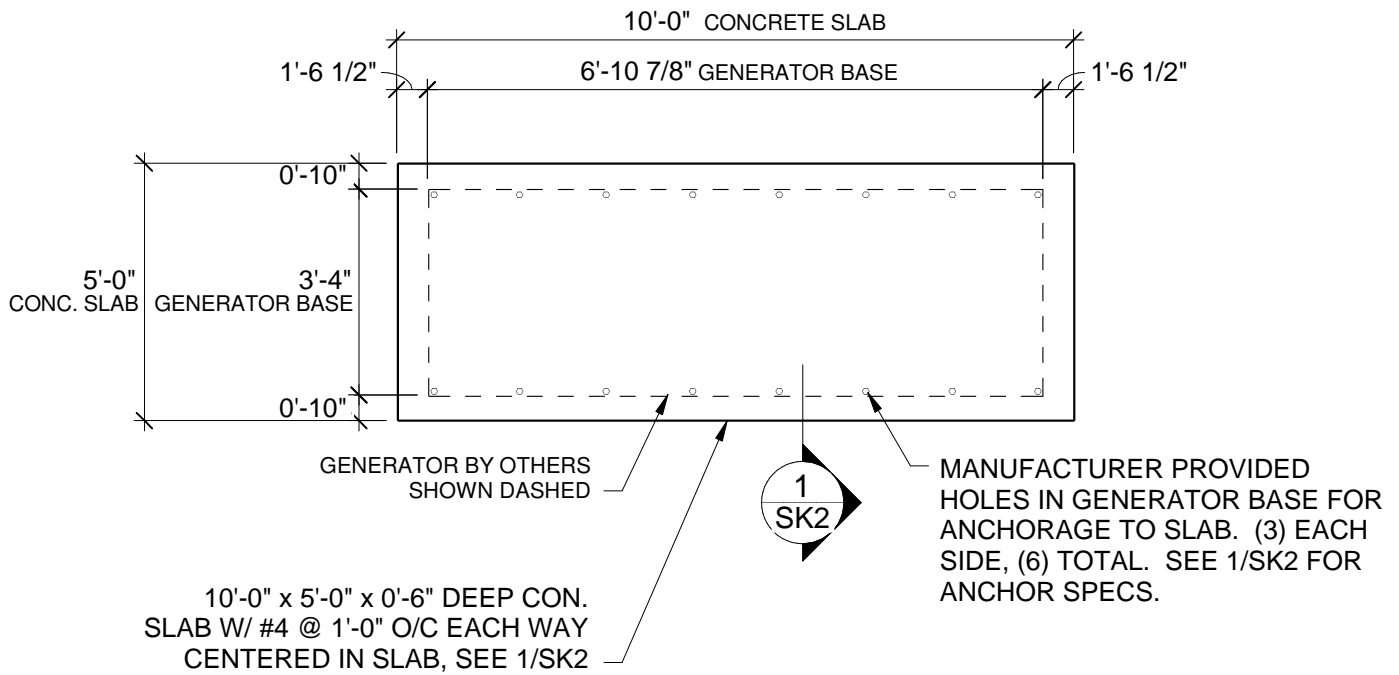
THE CONTRACTOR SHALL COORDINATE SEISMIC RESTRAINTS OF ELECTRICAL EQUIPMENT, MECHANICAL, PLUMBING, FIRE SPRINKLER, MACHINERY, AND ASSOCIATED PIPING WITH THE STRUCTURE. ANY CONNECTIONS TO STRUCTURE NOT CONFORMING TO SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA), OR SPECIFICALLY DETAILED ON THE MECHANICAL ENGINEER'S DRAWINGS, SHALL BE DESIGNED IN ACCORDANCE OF THESE GENERAL NOTES, BY AN ENGINEER REGISTERED IN THE STATE OF OREGON, AND SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO FABRICATION.

INSPECTION:

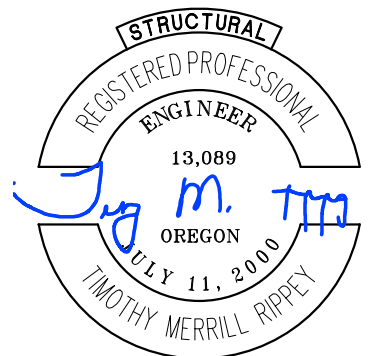
SPECIAL INSPECTIONS: IN ACCORDANCE WITH SECTION 1704 OF THE IBC AND APPLICABLE SECTIONS OF THE PROJECT SPECIFICATIONS. SPECIAL INSPECTIONS ARE TO BE PERFORMED BY AN INDEPENDENT TESTING LABORATORY EMPLOYED BY THE OWNER FOR THE AREAS INDICATED BELOW.

1. ADHESIVE ANCHOR (PERIODIC)
2. PLACEMENT OF CONCRETE AND CONCRETE REINFORCING (PERIODIC)

THE CONTRACTOR AND SPECIAL INSPECTOR SHALL NOTIFY THE ENGINEER OF RECORD OF ANY ITEM NOT COMPLYING WITH THE PROJECT SPECIFICATIONS AND/OR APPLICABLE CODES BEFORE PROCEEDING WITH ANY WORK INVOLVING THAT ITEM. THE ENGINEER OF RECORD WILL REVIEW THE ITEM AND DETERMINE ACCEPTABILITY. IF WORK INVOLVING THAT ITEM PROCEEDS WITHOUT THE APPROVAL OF THE ENGINEER OF RECORD THEN THE WORK WILL BE CONSIDERED NON-COMPLIANT.



1 SK1 GENERATOR SLAB PLAN



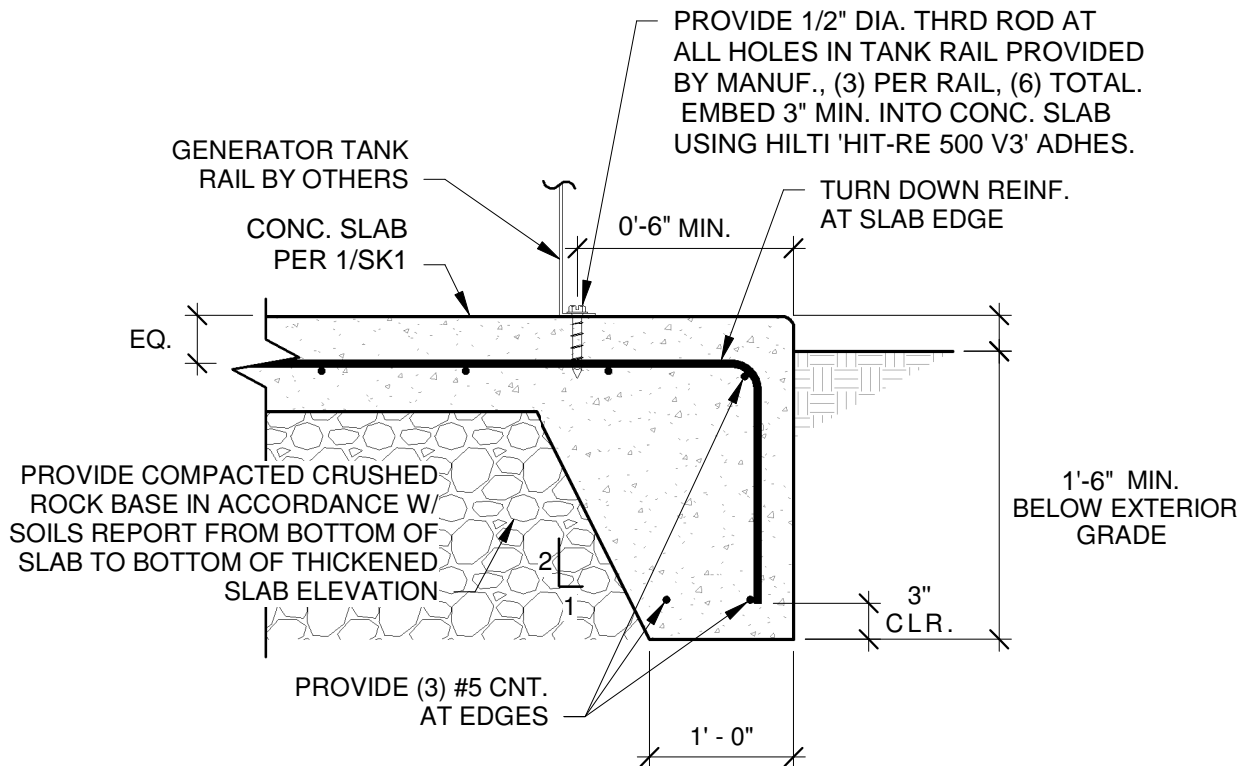
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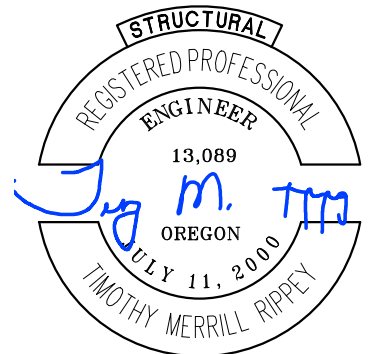
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Tigard, Oregon 97223
Phone (503) 443-3900

FIR GROVE ELEMENTARY SCHOOL
GENERATOR ANCHORAGE

BY KJ DATE _____
CHK BY _____ DATE _____
JOB NO. 21460
SHEET SK1 OF _____



1
SK2 GENERATOR SLAB DETAIL



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FIR GROVE ELEMENTARY SCHOOL
GENERATOR ANCHORAGE

BY KJ DATE _____
CHK BY _____ DATE _____
JOB NO. 21460
SHEET SK2 OF _____

Generator Pad: Anchorage

V = 103 mph (Risk Cat. III) EXP. B

S_{DS} = 0.698

Generator wgt (w/ fuel) = 1720 lbs + 800 lbs = 2520 lbs.

C.O.G. = 1/3 (47.5") = 15.8"

Wind: Ch. 29.4

$$F = q_z G C_f A_f$$

$$\rightarrow q_z = 0.00256 \left(\frac{0.57}{K_z} \right) \left(\frac{1.0}{K_{zt}} \right) \left(\frac{0.90}{K_d} \right) \left(\frac{1.0}{K_e} \right) (103)^2 = 14.5 \text{ psf}$$

G = 0.85

$$C_f (h/D = 0.72) = 1.3$$

$$F = \frac{(14.5 \text{ psf})(0.85)(1.3)(59.5' \times 82.8')}{16.02 > 16 \text{ o.k.}} = 548.2 \text{ lbs. @ } 1/2(59.5') = 30"$$

Seismic:

$$F_p = \frac{0.4 a_p S_{DS} W_p}{(R_p / I_p)} \left(1 + 2 \frac{z}{h} \right) = \frac{0.4 (1) (0.703) W_p}{(2.5 / 1.5)} (1) = 0.1687 W_p$$

$$F_{pmin} = 0.3 (0.703) (1.5) W_p = 0.316 W_p \leftarrow \text{controls}$$

$$F_p = 0.316 (2520 \text{ lbs}) = 797 \text{ lbs.}$$

O.T. Check:

$$(0.9 - 0.2 \times 0.703) D + E: M_o = (797 \text{ lbs})(15.8'') = 1049 \text{ lb}\cdot\text{ft}$$

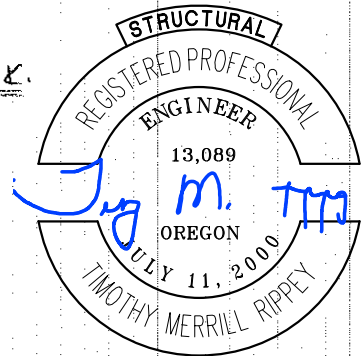
$$M_R = (0.7524)(2520 \text{ lbs})(30''/2) = 3030 \text{ lb}\cdot\text{ft} > M_o$$

$$V = 797 \text{ lbs} / 6 \text{ anchors} = 133 \text{ lbs/anchor} \times (SL = 2.0) = 266 \text{ lbs}$$

$$\rightarrow 1/2" \phi \times 3" \text{ embed capacity} = 1927 \text{ lbs} >> 266 \text{ lbs.}$$

$$0.9D + W: M_o = (548.2 \text{ lbs})(30'') = 1371 \text{ lb}\cdot\text{ft} < 3030$$

O.K.



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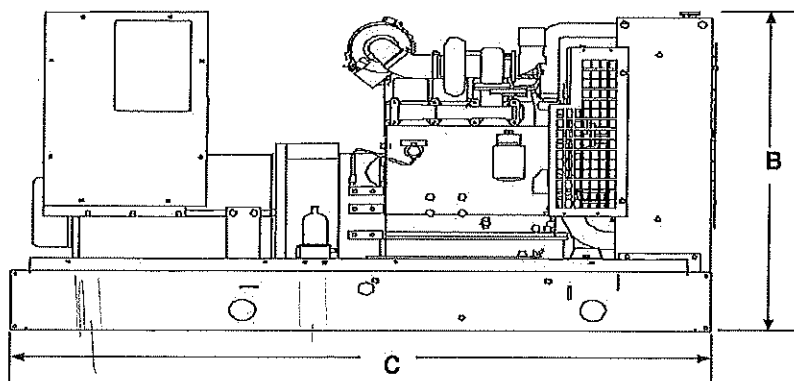
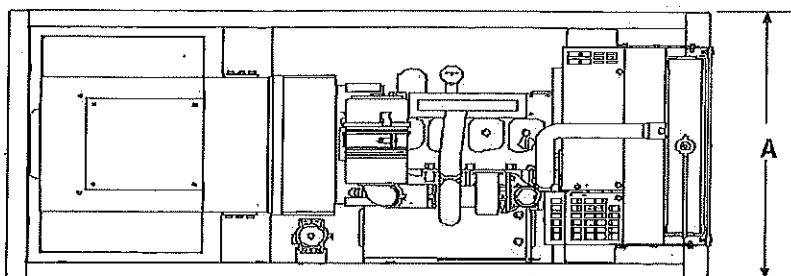
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Phone (503) 443-3900

BY KJ DATE _____

CHK BY _____ DATE _____

JOB NO 21460

SHEET C1 OF _____



This outline drawing is to provide representative configuration details for the model series.

See respective model data sheet for specific model outline drawing number.

Do not use for installation design

* Add 600 lbs. for fuel
* Provide a 60" x 120" PAD.

Model	Dim "A"		Dim "B"		Dim "C"		Weight Wet	
DGBB	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1688 lb.	757 kg
DGBC	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1688 lb.	757 kg
DGCA	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1720 lb.	780 kg
DGCB	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1720 lb.	780 kg

See your distributor for more information.



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Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
612-574-5000
Fax: 612-574-8087

Backfeed to a utility system can cause electrocution and/or property damage. Do not connect to any building's electrical system except through an approved device or after building main switch is opened.

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Onan and PowerCommand are registered trademarks of Onan Corporation

C2

Company:
 Specifier:
 Address:
 Phone | Fax:
 E-Mail:

Page: 1
 Project:
 Sub-Project | Pos. No.:
 Date: 3/20/2020

Specifier's comments:

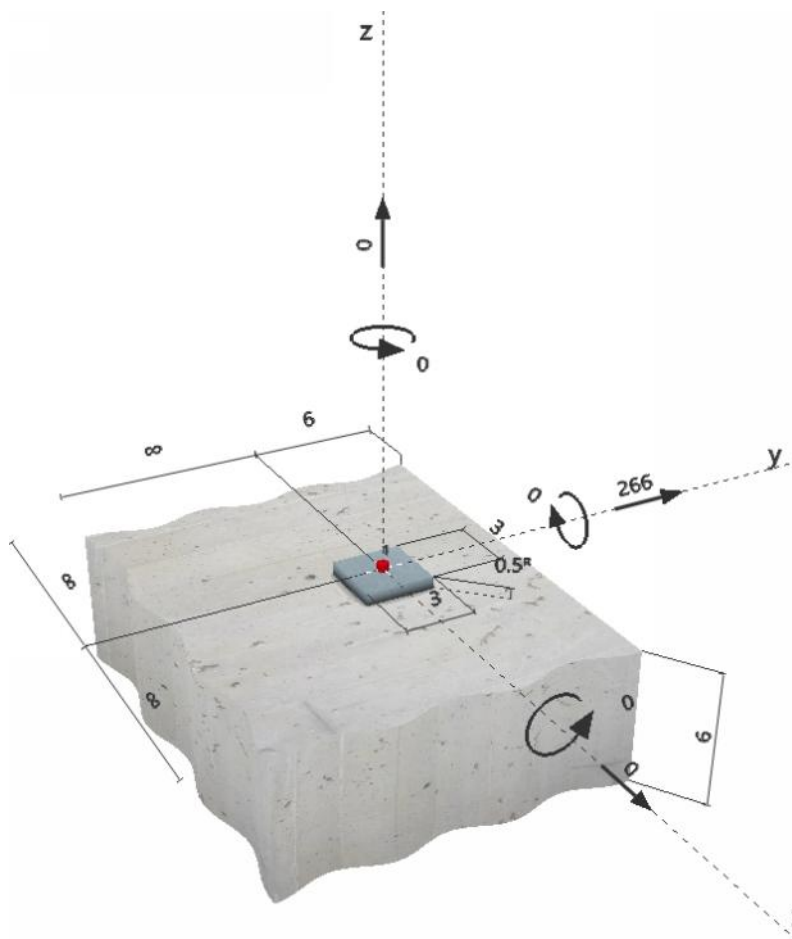
1 Input data

Anchor type and diameter: HIT-RE 500 V3 + HAS-V-36 (ASTM F1554 Gr.36) 1/2
Effective embedment depth: $h_{ef, opti} = 2.750$ in. ($h_{ef, limit} = 4.750$ in.)
Material: ASTM A 1554 Grade 36
Evaluation Service Report: ESR-3814
Issued | Valid: 1/1/2017 | 1/1/2019
Proof: Design method ACI 318-11 / Chem
Stand-off installation: $e_b = 0.000$ in. (no stand-off); $t = 0.500$ in.
Anchor plate: $l_x \times l_y \times t = 3.000$ in. x 3.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile: no profile
Base material: cracked concrete, 3000, $f'_c = 3,000$ psi; $h = 6.000$ in., Temp. short/long: 32/32 °F
Installation: hammer drilled hole, Installation condition: Dry
Reinforcement: tension: condition A, shear: condition A; no supplemental splitting reinforcement present
 edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F) Tension load: yes (D.3.3.4.3 (d))
 Shear load: yes (D.3.3.5.3 (c))



^R - user is responsible to ensure a rigid base plate for the entered thickness with appropriate solutions (stiffeners,...)

Geometry [in.] & Loading [lb, in.lb]



Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 2
 Project:
 Sub-Project | Pos. No.:
 Date: 3/20/2020

2 Proof I Utilization (Governing Cases)

Loading	Proof	Design values [lb]		Utilization	
		Load	Capacity	β_N / β_V [%]	Status
Tension	-	-	-	- / -	-
Shear	Steel Strength	266	1,927	- / 14	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	-	-	-	-	-

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.



Search Information

Address:	6300 SW Wilson Ave, Beaverton, OR 97008, USA
Coordinates:	45.47372240000001, -122.8182661
Elevation:	256 ft
Timestamp:	2021-11-18T00:53:22.583Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	III
Site Class:	D-default



Basic Parameters

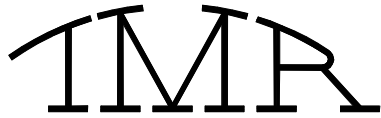
Name	Value	Description
S_S	0.872	MCE_R ground motion (period=0.2s)
S_1	0.404	MCE_R ground motion (period=1.0s)
S_{MS}	1.047	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.698	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

▼Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.885	Coefficient of risk (0.2s)
CR_1	0.867	Coefficient of risk (1.0s)
PGA	0.398	MCE_G peak ground acceleration
F_{PGA}	1.202	Site amplification factor at PGA
PGA_M	0.479	Site modified peak ground acceleration

C5



TM RIPPEY
CONSULTING ENGINEERS

7650 S. W. Beveland St.
Tigard, Oregon 97223
Phone: (503) 443-3900
Fax: (503) 443-3700

STRUCTURAL CALCULATIONS

PROJECT: BEAVERTON SD –SEXTON MTN ELEM. GENERATOR PAD

LOCATION: 15645 SW SEXTON MTN. RD.
BEAVERTON, OR

CLIENT: MKE & ASSOCIATES, INC.

DATE: NOVEMBER 18, 2020

PROJECT NUMBER: 21460

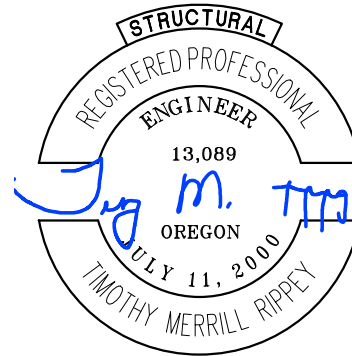


TABLE OF CONTENTS:

EXPIRES: 12-31-22

ITEM	SHEET NUMBER
GENERAL NOTES	N1 – N2
SKETCHES	SK1 – SK2
CALCULATIONS	C1 – C5

DESCRIPTION:

THIS DESIGN PACKAGE INCLUDES SKETCHES AND CALCULATIONS FOR ANCHORAGE OF ONE (1) GENERATOR UNIT AT THE ADDRESS NOTED ABOVE.

GENERAL STRUCTURAL NOTES

CODE REQUIREMENTS:

CONFORM TO THE 2018 INTERNATIONAL BUILDING CODE AS AMENDED BY THE 2019 OREGON STRUCTURAL SPECIALTY CODE, REFERENCED HEREFTER AS IBC.

DESIGN CRITERIA:

DESIGN WAS BASED ON THE STRENGTH AND DEFLECTION CRITERIA OF THE IBC. IN ADDITION TO THE DEAD LOADS, THE FOLLOWING LOADS WERE USED FOR DESIGN:

GENERATOR UNIT = 2520 LBS

SEISMIC IMPORTANCE FACTOR I_e : 1.25

SITE CLASS: D (ASSUMED)

SDS = 0.689

BASIC WIND SPEED (3-SEC GUST, ULTIMATE): 103 MPH

WIND EXPOSURE: B

BUILDING RISK CATEGORY: III

TEMPORARY CONDITIONS:

THE CONTRACTOR SHALL BE RESPONSIBLE FOR STRUCTURAL STABILITY OF THE NEW AND EXISTING STRUCTURES AND WALLS DURING CONSTRUCTION. THE STRUCTURE SHOWN ON THE DRAWINGS HAS BEEN DESIGNED FOR STABILITY UNDER THE FINAL CONFIGURATION ONLY.

EARTHWORK:

MAINTAIN THE EXCAVATION FREE FROM GROUND WATER FOR THE TIME REQUIRED TO COMPLETE THE WORK IN A PROPER WORKMANLIKE MANNER. REMOVE LOOSE OR DISTURBED SOIL FROM THE BOTTOMS OF EXCAVATION. FOOTINGS SHALL BEAR ON UNDISTURBED NATIVE SOIL OR ENGINEERED STRUCTURAL FILL.

WHERE COMPACTED AREAS ARE DISTURBED BY CONSTRUCTION OPERATIONS OR ADVERSE WEATHER, OVER EXCAVATE AND BACKFILL WITH 3/4" MINUS CRUSHED ROCK COMPACTED TO MINIMUM OF 95% OF THE DRY DENSITY AS MEASURED BY AASHTO T180. AT DISTURBED AREAS WITHIN 3'-0" OF BUILDING FOUNDATIONS COMPACT TO MINIMUM 95% OF THE DRY DENSITY AS MEASURED BY AASHTO T180.

CAST-IN-PLACE CONCRETE:

MIX DESIGN: PREPARE DESIGN MIXES FOR EACH TYPE OF CONCRETE. PROPORTION MIXES BY EITHER LABORATORY TRIAL BATCH OR FIELD EXPERIENCE METHODS, USING MATERIALS TO BE EMPLOYED ON THE WORK FOR EACH CLASS OF CONCRETE REQUIRED. FURNISH CERTIFIED REPORTS OF EACH PROPOSED MIX FOR EACH TYPE OF WORK OF THIS SECTION. THE CONTRACTOR SHALL SUBMIT CONCRETE MIX DESIGNS, ALONG WITH TEST DATA AS REQUIRED, A MINIMUM OF TWO WEEKS PRIOR TO PLACING CONCRETE.

ADMIXTURES: AIR ENTRAINING AGENT IN ACCORDANCE WITH ASTM C260 AND WATER-REDUCING ADMIXTURE CONFORMING TO ASTM 494, USED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS, MAY BE INCORPORATED IN CONCRETE DESIGN MIXES. AN AIR-ENTRAINING AGENT CONFORMING TO ASTM C260 SHALL BE USED IN CONCRETE MIXES FOR EXTERIOR HORIZONTAL SURFACES EXPOSED TO WEATHER. THE AMOUNT OF ENTRAINED AIR SHALL BE 5% - 7% BY VOLUME. FLY ASH SHALL CONFORM TO ASTM C 618 AND SHALL BE LIMITED TO A 15% MAXIMUM BY CEMENT WEIGHT.

CONCRETE WORK SHALL CONFORM TO ACI 301. CONCRETE STRENGTHS SHALL BE VERIFIED BY STANDARD 28-DAY CYLINDER TESTS PER ASTM C39, AND SHALL BE AS FOLLOWS:

SLABS: f'_c =4,000 PSI AT 28 DAYS. (MINIMUM CEMENT CONTENT = 517 LBS)

ABSOLUTE WATER/CEMENT RATIO BY WEIGHT:

f'_c = 4000 PSI (0.50 NON-AIR ENTRAINED, 0.45 AIR ENTRAINED)

HOT AND COLD WEATHER REQUIREMENTS FOR CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF ACI 318.

SLEEVES, OPENINGS, CONDUIT, AND OTHER EMBEDDED ITEMS NOT SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE

TM RIPPEY
Consulting Engineers
7650 SW Beveland Street
Suite 100
Tigard, Oregon 97223
Phone: (503) 443-3900

By: KMJ Date: _____
SEXTON MTN ELEMENTARY SCHOOL Chk By: _____ Date: _____
GENERATOR ANCHORAGE Job #: 21460
Sheet: N1 Of: _____

APPROVED BY THE STRUCTURAL ENGINEER BEFORE POURING. CONDUITS EMBEDDED IN SLABS SHALL NOT BE LARGER THAN ONE THIRD OF THE THICKNESS OF THE SLAB AND SHALL NOT BE SPACED CLOSER THAN THREE DIAMETERS ON CENTER. PROVIDE 3/4" CHAMFERS ON ALL EXPOSED CONCRETE EDGES UNLESS NOTED OTHERWISE.

CONCRETE REINFORCING STEEL:

REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60 FOR DEFORMED BARS, UNLESS OTHERWISE NOTED. REINFORCING STEEL TO BE WELDED SHALL CONFORM TO ASTM A706. REINFORCING STEEL TO BE HOT DIP GALVANIZED SHALL CONFORM TO ASTM 767. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A82 AND A185.

REINFORCING STEEL SHALL BE DETAILED IN ACCORDANCE WITH ACI 315 LATEST EDITION ("DETAILS AND DETAILING CONCRETE REINFORCEMENT").

UNLESS NOTED OTHERWISE ON THE DRAWINGS LAP SPLICE LENGTHS SHALL BE 50 BAR DIAMETERS

REINFORCING STEEL SHALL HAVE PROTECTION AS FOLLOWS:

CONDITION:	MINIMUM COVER:
CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO EARTH:	3"

CONCRETE EXPOSED TO EARTH AND WEATHER:	
NO.6 THROUGH NO.18 BARS	2"

CONCRETE ACCESSORIES:

CONCRETE EPOXY/ADHESIVE ANCHORS SHALL BE INSTALLED WITH "HILTI HIT-RE 500 V3" (OR ENGINEER APPROVED EQUIVALENT) INSTALLED PER MANUFACTURER'S GUIDELINES AND CURRENT ESR REPORT, AND SHALL MEET THE FOLLOWING CRITERIA:

- A. ADHESIVE ANCHORS SHALL BE INSTALLED BY QUALIFIED PERSONNEL TRAINED TO INSTALL ADHESIVE ANCHORS IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND WITH STRICT ADHERENCE TO THE PROVISIONS WITHIN THE MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS.
- B. AT THE TIME OF ANCHOR INSTALLATION, IN ACCORDANCE WITH ACI 318-11 SECTION D.2.2, ADHESIVE ANCHORS SHALL BE INSTALLED IN CONCRETE HAVING A MINIMUM AGE OF 21 DAYS.

MECHANICAL:

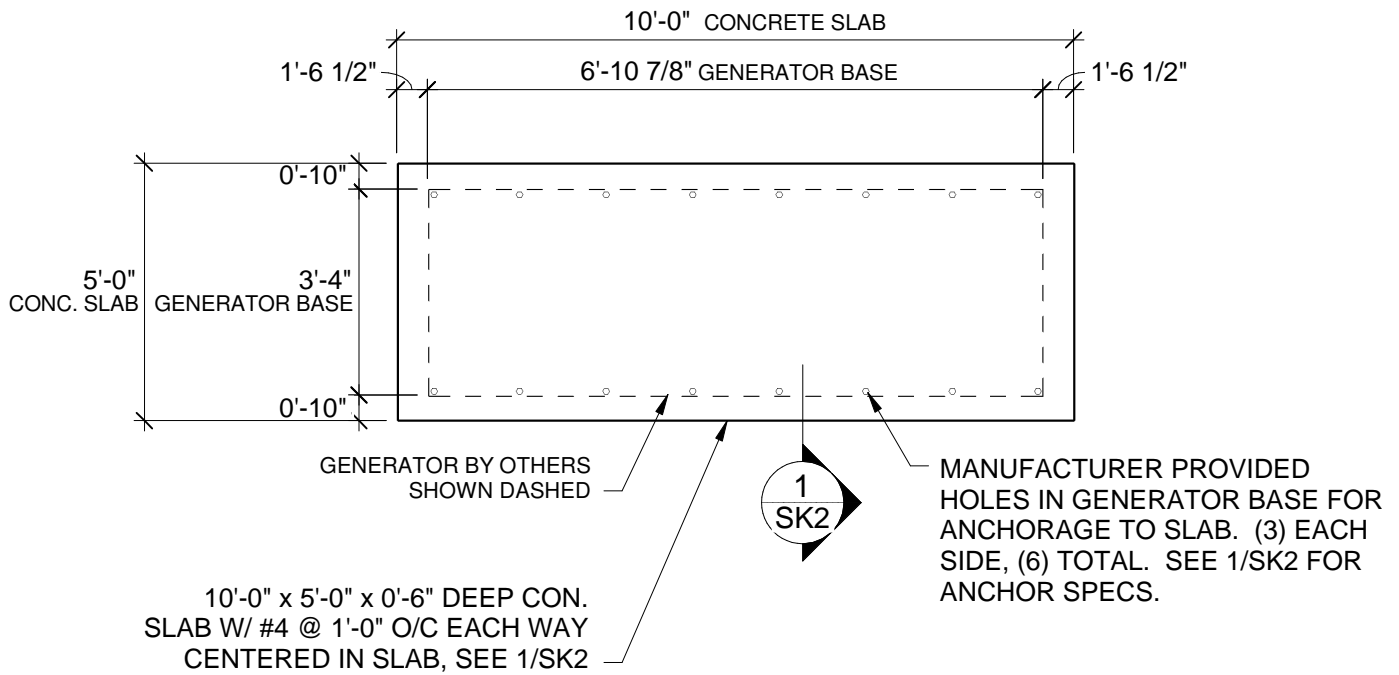
THE CONTRACTOR SHALL COORDINATE SEISMIC RESTRAINTS OF ELECTRICAL EQUIPMENT, MECHANICAL, PLUMBING, FIRE SPRINKLER, MACHINERY, AND ASSOCIATED PIPING WITH THE STRUCTURE. ANY CONNECTIONS TO STRUCTURE NOT CONFORMING TO SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA), OR SPECIFICALLY DETAILED ON THE MECHANICAL ENGINEER'S DRAWINGS, SHALL BE DESIGNED IN ACCORDANCE OF THESE GENERAL NOTES, BY AN ENGINEER REGISTERED IN THE STATE OF OREGON, AND SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO FABRICATION.

INSPECTION:

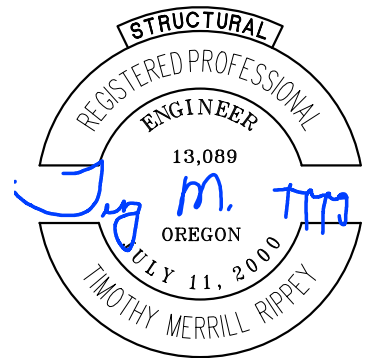
SPECIAL INSPECTIONS: IN ACCORDANCE WITH SECTION 1704 OF THE IBC AND APPLICABLE SECTIONS OF THE PROJECT SPECIFICATIONS. SPECIAL INSPECTIONS ARE TO BE PERFORMED BY AN INDEPENDENT TESTING LABORATORY EMPLOYED BY THE OWNER FOR THE AREAS INDICATED BELOW.

1. ADHESIVE ANCHOR (PERIODIC)
2. PLACEMENT OF CONCRETE AND CONCRETE REINFORCING (PERIODIC)

THE CONTRACTOR AND SPECIAL INSPECTOR SHALL NOTIFY THE ENGINEER OF RECORD OF ANY ITEM NOT COMPLYING WITH THE PROJECT SPECIFICATIONS AND/OR APPLICABLE CODES BEFORE PROCEEDING WITH ANY WORK INVOLVING THAT ITEM. THE ENGINEER OF RECORD WILL REVIEW THE ITEM AND DETERMINE ACCEPTABILITY. IF WORK INVOLVING THAT ITEM PROCEEDS WITHOUT THE APPROVAL OF THE ENGINEER OF RECORD THEN THE WORK WILL BE CONSIDERED NON-COMPLIANT.



1 SK1 GENERATOR SLAB PLAN



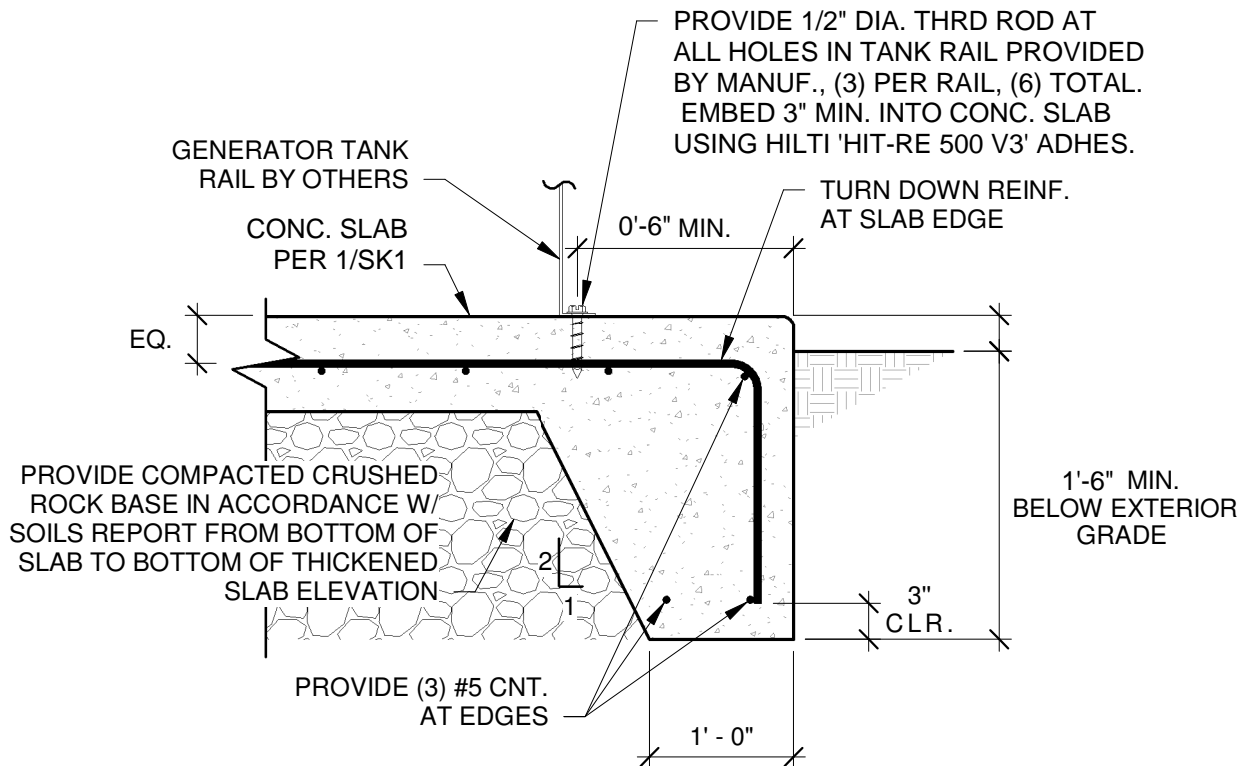
EXPIRES: 12-31-22

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CONSULTING ENGINEERS

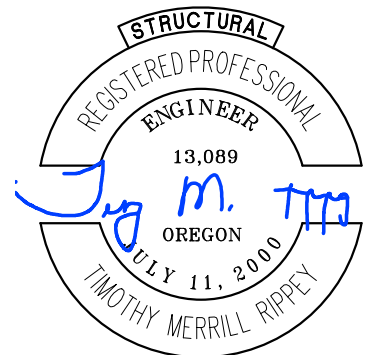
7650 S.W. Beveland St, Suite 100
Tigard, Oregon 97223
Phone (503) 443-3900

SEXTON MOUNTAIN ELEMENTARY SCHOOL
GENERATOR ANCHORAGE

BY KJ DATE _____
CHK BY _____ DATE _____
JOB NO. 21460
SHEET SK1 OF _____



1
SK2 GENERATOR SLAB DETAIL



EXPIRES: 12-31-22

Generator Pad & Anchorage

V = 103 mph (Risk Cat. III) EXP. B

$S_{DS} = 0.689$

Generator wgt (w/ fuel) = 1720 lbs + 800 lbs = 2520 lbs.

C.O.G. = $\frac{1}{3}(47.5") = 15.8"$

Wind: Ch. 29.4

$$F = q_z G C_f A_f$$

$$\rightarrow q_z = 0.00256 \left(\frac{0.57}{K_z} \right) \left(\frac{1.0}{K_{zt}} \right) \left(\frac{0.90}{K_d} \right) \left(\frac{1.0}{K_e} \right) (103)^2 = 14.5 \text{ psf}$$

$G = 0.85$

$$C_f (h/D = 0.72) = 1.3$$

$$F = \frac{(14.5 \text{ psf})(0.85)(1.3)(59.5' \times 82.8')}{16.02 > 16 \text{ o.k.}} = 548.2 \text{ lbs. @ } \frac{1}{2}(59.5') = 30"$$

Seismic:

$$F_p = \frac{0.4 a_p S_{DS} W_p}{(R_p / I_p)} \left(1 + 2 \frac{z}{h} \right) = \frac{0.4(1)(0.703) W_p}{(2.5 / 1.5)} (1) = 0.1687 W_p$$

$$F_{pmin} = 0.3(0.703)(1.5) W_p = 0.316 W_p \leftarrow \text{controls}$$

$$F_p = 0.316(2520 \text{ lbs}) = 797 \text{ lbs.}$$

O.T. Check:

$$(0.9 - 0.2 \times 0.703) D + E: M_o = (797 \text{ lbs})(15.8") = 1049 \text{ lb.ft}$$

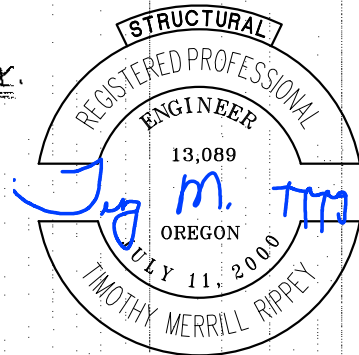
$$M_R = (0.7524)(2520 \text{ lbs.})(30"/2) = 3030 \text{ lb.ft} > M_o$$

$$V = 797 \text{ lbs} / 6 \text{ anchors} = 133 \text{ lbs/anchor} \times (SL = 2.0) = 266 \text{ lbs}$$

$$\rightarrow \frac{1}{2}" \phi \times 3" \text{ embed capacity} = 1927 \text{ lbs} >> 266 \text{ lbs.}$$

$$0.9D + W: M_o = (548.2 \text{ lbs})(30") = 1371 \text{ lb.ft} < 3030$$

O.K.



EXPIRES: 12-31-22

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CONSULTING ENGINEERS

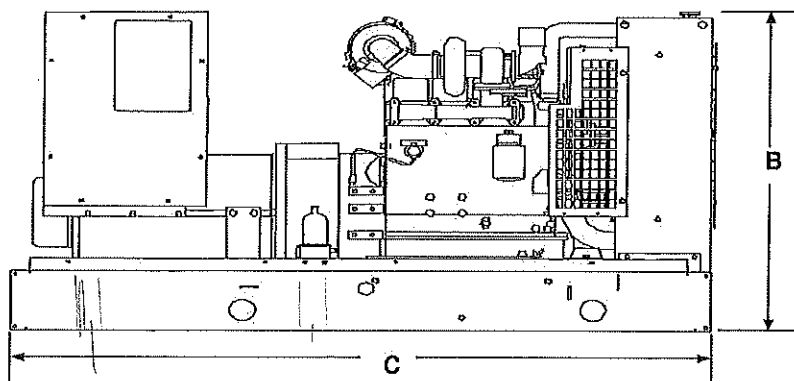
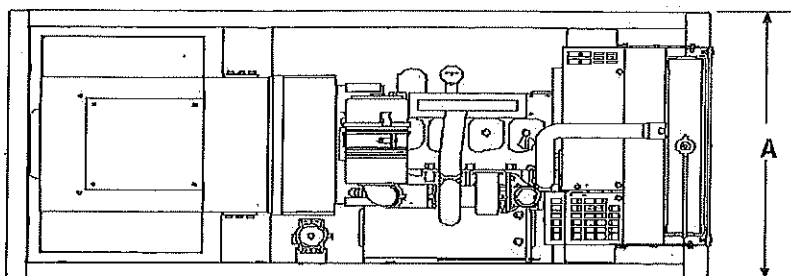
7650 S.W. Beveland St, Suite 100
Tigard, Oregon 97223
Phone (503) 443-3900

BY KJ DATE _____

CHK BY _____ DATE _____

JOB NO. 21460

SHEET C1 OF _____



This outline drawing is to provide representative configuration details for the model series.

See respective model data sheet for specific model outline drawing number.

Do not use for installation design

* Add 600 lbs. for fuel
* Provide a 60" x 120" PAD.

Model	Dim "A"		Dim "B"		Dim "C"		Weight Wet	
DGBB	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1688 lb.	757 kg
DGBC	40 in	1016 mm	47.5 in	1207 mm	82.8 in	2103 mm	1688 lb.	757 kg
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Cummins is a registered trademark of Cummins Engine Company

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C2

Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 1
 Project:
 Sub-Project | Pos. No.:
 Date: 3/20/2020

Specifier's comments:

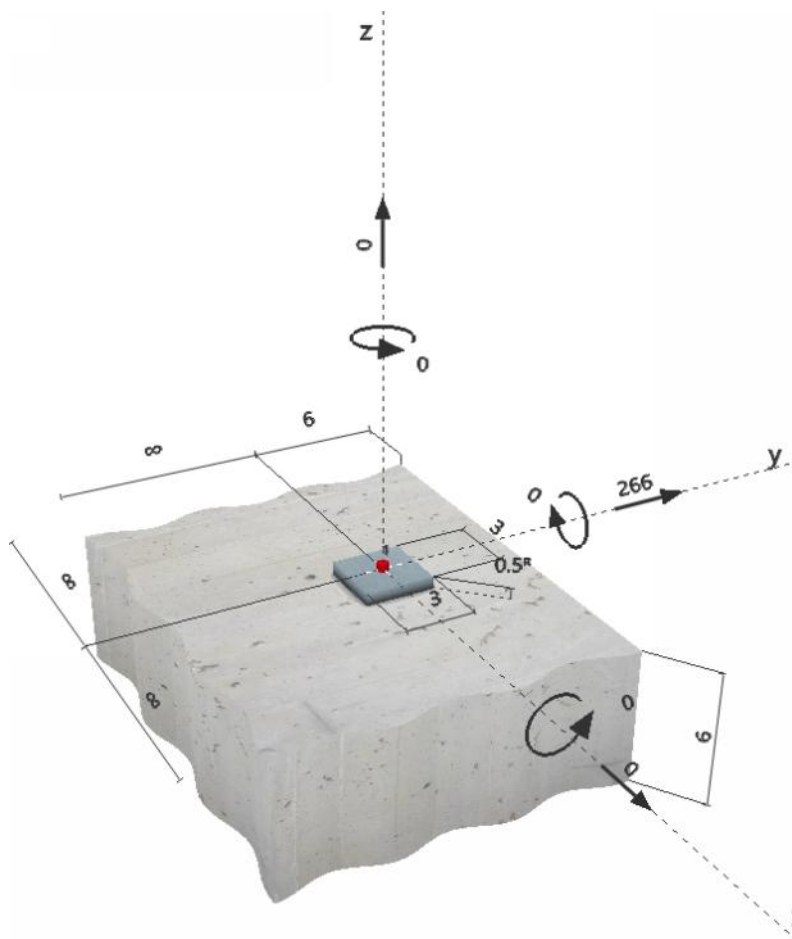
1 Input data

Anchor type and diameter: HIT-RE 500 V3 + HAS-V-36 (ASTM F1554 Gr.36) 1/2"
Effective embedment depth: $h_{ef, opti} = 2.750$ in. ($h_{ef, limit} = 4.750$ in.)
Material: ASTM A 1554 Grade 36
Evaluation Service Report: ESR-3814
Issued | Valid: 1/1/2017 | 1/1/2019
Proof: Design method ACI 318-11 / Chem
Stand-off installation: $e_b = 0.000$ in. (no stand-off); $t = 0.500$ in.
Anchor plate: $l_x \times l_y \times t = 3.000$ in. \times 3.000 in. \times 0.500 in.; (Recommended plate thickness: not calculated)
Profile: no profile
Base material: cracked concrete, 3000, $f'_c = 3,000$ psi; $h = 6.000$ in., Temp. short/long: 32/32 °F
Installation: hammer drilled hole, Installation condition: Dry
Reinforcement: tension: condition A, shear: condition A; no supplemental splitting reinforcement present
 edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F) Tension load: yes (D.3.3.4.3 (d))
 Shear load: yes (D.3.3.5.3 (c))



^R - user is responsible to ensure a rigid base plate for the entered thickness with appropriate solutions (stiffeners,...)

Geometry [in.] & Loading [lb, in.lb]



Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 2
 Project:
 Sub-Project | Pos. No.:
 Date: 3/20/2020

2 Proof I Utilization (Governing Cases)

Loading	Proof	Design values [lb]		Utilization	
		Load	Capacity	β_N / β_V [%]	Status
Tension	-	-	-	- / -	-
Shear	Steel Strength	266	1,927	- / 14	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	-	-	-	-	-

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

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Search Information

Address:	15645 SW Sexton Mountain Dr, Beaverton, OR 97007, USA
Coordinates:	45.45840870000001, -122.8373331
Elevation:	277 ft
Timestamp:	2021-11-18T01:02:01.912Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	III
Site Class:	D-default



Basic Parameters

Name	Value	Description
S_S	0.861	MCE_R ground motion (period=0.2s)
S_1	0.402	MCE_R ground motion (period=1.0s)
S_{MS}	1.033	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.689	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

▼Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.883	Coefficient of risk (0.2s)
CR_1	0.867	Coefficient of risk (1.0s)
PGA	0.394	MCE_G peak ground acceleration
F_{PGA}	1.206	Site amplification factor at PGA
PGA_M	0.475	Site modified peak ground acceleration

C5