

SECTION 00010

TABLE OF CONTENTS

DIVISION 01 ARCHITECTURAL

SECTION 01 56 39 TREE AND PLANT PROTECTION

DIVISION 03 STRUCTURAL

SECTION 03 10 00 CONCRETE FORMWORK

SECTION 03 20 00 CONCRETE REINFORCEMENT

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

DIVISION 26 ELECTRICAL

SECTION 26 00 00 ELECTRICAL GENERAL REQUIREMENTS

SECTION 26 05 00 BASIC ELECTRICAL MATERIALS AND METHODS

SECTION 26 05 23 CONDUCTORS AND CABLES

SECTION 26 05 26 GROUNDING AND BONDING

SECTION 26 05 33 RACEWAYS AND BOXES

SECTION 26 05 53 ELECTRICAL IDENTIFICATION

SECTION 26 22 00 DRY TYPE TRANSFORMERS

SECTION 26 24 16 PANELBOARDS

SECTION 26 28 16 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

SECTION 26 32 13 PACKAGED ENGINE GENERATOR

SECTION 26 36 00 TRANSFER SWITCH

DIVISION 32 EXTERIOR IMPROVEMENTS

SECTION 32 12 16 AC PAVING

SECTION 32 31 13 CHAINLINK FENCING

SECTION 01 56 39
TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Furnish all labor, materials, equipment, facilities, transportation and services to complete tree protection and related work as shown on the drawings and/or specified herein.
- B. Description of Work:
 - 1. Protection of existing trees and vegetation to remain.
 - 2. Trimming of existing trees.
 - 3. Maintenance of existing trees and vegetation during construction.
 - 4. Removal of existing trees and other vegetation.
- C. Traffic:
 - 1. Do not interfere with or close public ways without permission of the District.
 - 2. Do not interfere with adjacent private properties without permission of the District.
- D. Site Utilities:
 - 1. Advise utility companies of excavation activities before starting excavations.
 - 2. Locate and identify underground utilities passing through work area before starting work.
 - 3. In event unidentified underground utilities are encountered during work, advise utility owner immediately before proceeding. Add any new utility information to project record drawings for actual location.
 - 4. Protect all existing-to-remain utilities.
 - 5. Do not interrupt existing utilities without advance notice to and approval from the District.

1.03 QUALITY ASSURANCE

- A. Contractor shall be liable for the loss in value to damaged trees and for all repair costs resulting as determined by the District. Due to the irreplaceable nature of many existing trees, the liability to the General Contractor shall be set at \$500.00 minimum per tree. The Trunk Formula method for Northern California established by the International Society of Arboriculture must be used to compute the actual value.
- B. Arborist Qualifications: Certified Arborist as certified by the International Society of Arboriculture (ISA) and having performed similar services for a minimum of five (5) years.

1.04 SUBMITTALS

A. In the event work is required within the dripline of existing to remain trees and vegetation, Contractor shall retain the services of a Certified Arborist for the preservation of the tree(s) and submit written recommendations from Arborist to Owner's Representative for review prior to implementation. Contractor shall follow recommendations of Arborist and contact Arborist for further review and recommendations if the tree(s) begin to decline in health.

PART 2 - PRODUCTS

2.01 TREE PROTECTION PROTECTIVE FENCE

- A. Existing vegetation and/or trees to remain on the site shall be protected with a four (4) foot high orange plastic snow fence. Fence shall be mounted on wooden lodgepole posts driven into the ground every six (6) feet to a depth of at least two (2) feet. Fence shall be erected and installed around the perimeter dripline (area directly under the outer circumference of the branches) of each shrub, tree or groups of shrubs or trees to remain.
- B. Snow Fence: Orange, UV resistance, .3 inch thickness, 48 inches in width, oval mesh, extruded thermal plastic polymer, Tenax or equal, fence fabric.
- C. During planting and irrigation operations, protective fencing is not required beneath existing to remain trees and shrubs that fall within the newly landscaped and/or irrigation area.

2.02 BARK MULCH

- A. Refer to Specification Section 32 96 00 "Landscape Planting" for match bark mulch material to use in non-bio-retention planting areas.
- B. If Specification Section 32 96 00 "Landscape Planting" is not issued as part of this project, bark mulch to be Pro-Chip decorative mulch, mahogany in color and available from Republic Services, Newberry Island Recyclery, Milpitas, CA, contact Glenn Bohling at (408) 687-1928 or GBohling@RepublicServices.com.

2.03 LODGEPOLE FENCE POSTS

- A. Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated Douglas Fir or lodgepole pine, free of knots, holes, cross grain, and other defects, two (2) inches in diameter by length required, and pointed at one end.

PART 3 – EXECUTION

3.01 PROTECTIVE FENCE INSTALLATION

- A. Install protective fencing before demolition or construction operations and maintain fence throughout construction.
- B. Protective fencing shall be erected to enclose the entire dripline of existing vegetation and/or trees to remain.

- C. For trees in narrow planting strips, only the planting strip should be enclosed with the re- quired fencing in order to keep walkways and streets open for public use.
 - D. Apply 3" layer bark mulch top dressing in areas beneath tree canopies and inside protective fence area.
 - E. Install a sign clearly indicating the area within the fence shall not be disturbed.
 - F. Protect tree canopy and branching to ensure branches and bark are not damaged during construction and canopy remains intact.
 - G. Maintain protective fencing at original location in vertical, undamaged condition until all contractors and subcontractors are complete.
- 3.02 MAINTENANCE OF EXISTING VEGETATION AND/OR TREES DURING CONSTRUCTION
- A. ARBORIST SUPERVISION
 - 1. For construction within ten (10) horizontal feet of a tree and/or shrub to remain, with a trunk diameter of twelve (12) inches or larger measured three (3) feet above original finish grade, Contractor shall retain the services of a reputable Arborist certified by the International Society of Arboriculture (ISA) to review the tree(s) and/or shrubs(s), the work to be performed and provide written recommendations to minimize the impact on existing trees and/or shrubs to remain. Submit recommendations to Owner's Representative for review.
 - 2. Contractor shall implement Arborist recommendations.
 - 3. Contractor shall consult Arborist for further recommendations if tree(s) and/or shrub(s) appear in failing health until final completion and acceptance of landscape work.
 - B. PRUNING
 - 1. Prune existing vegetation and/or trees to remain so that a balanced canopy is created and dead wood is removed. Neatly prune canopy where required to clear proposed buildings, roadways and pedestrian walkways. No more than 25% of the foliage may be removed. Pruning shall be performed under the direction and approval of the Owner's Representative. Pruning shall be performed under the supervision of a reputable Arborist certified by the International Society of Arboriculture (ISA).
 - 2. Prune trees and/or vegetation clear of walkways horizontally. Prune trees for an 80" vertical clearance where canopies extend above walkways and 14' clearance where canopies extend above roadways.
 - C. IRRIGATION
 - 1. Irrigate existing vegetation and/or trees to remain and those relocated during hot and/or dry periods and as required to maintain material in a healthy, vigorous condition.

D. ROOT ZONE PROTECTION

1. Where proposed finish grade is indicated below existing grade beneath tree canopy, maintain existing grade beneath canopy and slope grade outside the tree canopy area.
2. Avoid cutting utility trenches beneath shrub and/or tree canopies. If trenching is unavoidable, Contractor shall cut trenches by hand or with an air spade tool within tree canopy to expose roots without cutting them.
3. Roots larger than 2" in diameter shall remain and proposed pipes or utilities shall be snaked around or under roots.
4. Roots encountered smaller than 2" in diameter shall be cut and not torn for removal. Cleanly cut roots as close as possible to excavation.
5. In the event tree and/or shrub roots larger than 2" in diameter require removal, pruning shall be performed under the supervision a reputable Arborist certified by the International Society of Arboriculture (ISA).
6. Any roots which will be exposed for more than 8 hours shall be covered with wet burlap. Keep burlap moist until roots are buried.
7. Avoid rototilling beneath tree canopies or use of wheeled equipment.
8. Do not place or store equipment, materials, sheds, outhouses, debris or vehicles beneath dripline of existing to remain vegetation and/or trees to remain.
9. Protect existing vegetation and/or tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing or storing construction materials.
10. Protect root system from ponding, eroding or excessive wetting caused by dewatering operations.

3.03 REMOVAL OF EXISTING VEGETATION AND/OR TREES:

- A. Contractor shall remove and demolish from the site trees and vegetation indicated on the Drawings to be removed. Additional trees and vegetation conflicting with work require written approval by Owner's Representative.
- B. Tree removal shall include branches, leaves, roots, stumps and stump grindings to a minimum depth of 18" below proposed subgrade. Contractor shall fill depressions caused by removal with on-site or approved import topsoil fill material in planting areas or engineered fill beneath proposed hardscape and/or building pads.
- C. Properly dispose of debris off site in an acceptable manner.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMWORK

PART I – GENERAL

1.1 Description of Work

- A. Work under this section includes the furnishing and installing of all form work for cast-in-place concrete, complete, with all related accessories, items and incidentals required.

1.2 Applicable Standards (latest editions apply)

- A. ACI- American Concrete Institute
 - 1. 301, Specifications for Structural Concrete for Buildings.
 - 2. 318, Building Code Requirements for Reinforced Concrete.
 - 3. 347, Recommended Practice for Concrete Formwork.
- B. ICC – International Code Council, Inc.
 - 1. CBC - Section 1906A - 2013 California Building Code (California Code of Regulations, Title 24, Part 2)

PART II – PRODUCTS

2.1 Forming Materials

- A. Unless otherwise indicated, materials for formwork shall be wood, steel, fiber or reinforced plastic and of suitable quality to achieve required finishes. Contractor shall conform with considerations and recommendations in ACI-347, Chapter 3, Materials for Formwork.
- B. Unless otherwise indicated, contact surfaces in fabricated forms shall be smooth and uniform without warps, bends, dents, sags or irregular absorptive conditions and imperfections which might telegraph or product objectionable irregularities in the exposed concrete finish.
- C. Form ties and spreaders shall leave a hole not larger than 7/8-inch nor less than ½-inch in diameter in the concrete surface. The portion of the tie remaining in the concrete shall be at least 1-inch back from the concrete surface that will be exposed to view, painted, damp proofed or waterproofed.

- D. Chamfer strips: Milled from clear straight-grain lumber, surfaced on all sides. Other material of equal quality may be used only as authorized by Architect.
 - E. Round Column Forms: Sonotube or equal
- 2.2 Form Coatings: Form coating and bond breaking materials shall be non-staining and completely compatible with finish materials and other surface treatment materials to be used.
- 2.3 Other Materials:
- A. Sand Cushion & Membrane: Sand shall be clean, sharp and moist. Membrane shall be 15 mil. polyethylene sheet. Lap joints 6".
 - B. Rock Base: Caltrans Class II, ¾" aggregate max.

PART III – EXECUTION

3.1 Construction of Forms:

- A. The forms shall be constructed smooth, mortar-tight, true to the required lines and grade, and with sufficient strength to resist springing out of shape during the placing and vibrating of concrete. All dirt, chips, sawdust and other foreign matter shall be completely removed before concrete is placed. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being used.
- B. Before reinforcing steel is placed in forms, all inside surfaces of the forms shall be thoroughly coated with an approved form sealer. The form sealer shall be of high penetrating quality leaving no film on the surface of the forms that can be absorbed by the concrete or be incompatible with concrete paint.
- C. All exposed edges shall be chamfered with triangular fillets ½-inch by ½-inch.
- D. Joints in formwork for exposed walls and curbs shall be taped, where directed by Architect.

3.2 Earth Forms:

- A. Foundation concrete may be placed directly into neat excavations provided the foundation trench walls are stable as determined by the architect (Structural Engineer) subject to the approval of the Division of the State Architect. In such case the minimum formwork shown on the drawings is mandatory to insure clean excavations immediately prior to and during the pour.
- B. Remove loose dirt and debris prior to placement of concrete.

3.3 Stripping:

- A. Forms shall be removed in such manner as to insure the complete safety of the structure. Conform to minimum requirements established by ACI 347 for specific conditions.
- B. Formwork for walls and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.
- C. Whenever the formwork is removed during the curing period, the exposed concrete shall be protected and cured by one of the methods specified in Section 03 30 00.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART I – GENERAL

1.1 Description of Work

- A. Work under this Section includes the furnishing and installing of all steel reinforcing for cast-in-place concrete, complete, with all related items, accessories and incidentals required, such as ties, spacing devices inserts and all other material required to complete installation.

1.2 Applicable Standards (latest editions apply)

- A. ACI- American Concrete Institute:
 - 1. 301, Specifications for Structural Concrete for Buildings.
 - 2. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 3. 318, Building Code Requirements for Reinforced Concrete.
- B. ASTM- American Society for Testing and Materials, Referenced Standards
- C. AWS- American Welding Society:
 - 1. AD1.4 Structural Welding Code- Reinforcing Steel
 - 2. A5.1 Mild Steel Covered Arc-Welding Electrodes
- D. CRSI- Concrete Reinforcing Steel Institute:
 - 1. Manual of Standard Practice
 - 2. Recommended Practice for Placing Reinforcing Bars
- E. ICC- International Code Council:
 - 1. CBC – 2013 California Building Code (California Code of Regulations, Title 24, Part 2)

1.3 Submittals

- A. Shop Drawings of all reinforcing steel shall be submitted for approval.

- B. Mill Reports for each different heat to be used on the job shall be submitted for approval. Comply with CBC, Section 1916A.2.

1.4 Quality Assurance

- A. Welders shall be qualified in accordance with AWS D1.4.

PART II – PRODUCTS

2.1 Materials

- A. Reinforcing bars: Deformed, new billet-steel bars conforming to ASTM Designation A615, Grade 60 or ASTM A706 unless noted otherwise.
- B. Reinforcing mesh: Welded wire fabric conforming to ASTM A185.
- C. Tie wires and spirals: ASTM A82.
- D. Reinforcement supports
 - 1. At reinforcing placed over sand or earth, use precast concrete cubes.
 - 2. At reinforcing placed over forms, provide supports with legs which are hot dip galvanized, stainless steel or plastic protected.
- E. Mechanical Bar Splice: Xtender by Headed Reinforcement Corp. or equal to develop a minimum of 125% of yield strength of bar.

- 2.2 Fabrication: Except where specified otherwise herein or shown otherwise on the plans, reinforcing steel shall be cleaned, fabricated, placed, tied and supported in accordance with ACI 301 and ACI 315.

PART III – EXECUTION

3.1 Installation

- A. Reinforcing bars shall be accurately placed and shall be supported and secured against displacement by the use of adequate and proper supporting and spacing devices, tie wire, etc., so that it will remain in its correct location in the finished work. No supporting devices shall be used that will impede the flow of concrete.
- B. Do not bend or straighten reinforcing in any manner that will injure the material.

- C. Install splices for reinforcing bars in accordance with drawings and ACI 318. Stagger splices in adjacent bars 5' – 0".
- D. Reinforcing mesh shall be laid flat in place. Lap mesh at sides and ends 12 inches. Wire mesh together at 24 inches on center.

3.2 Clearances

- A. Where not shown otherwise on the drawings, the minimum concrete coverage for steel reinforcement shall be as follows:
 - 1. Where concrete is deposited against ground 3"
 - 2. Concrete in forms exposed to earth or weather 2"
- B. The clear spacing between parallel bars shall be not less than 1-1/2 times the normal diameter of the maximum size aggregate, and in no case less than 1-1/2 inches, except at splices which may be wired together.

3.3 Welding: Perform all welding in accordance with AWS D1.4.

3.4 Field Quality Control

- A. Contractor shall examine placement of all reinforcement and embedded items prior to inspection by Owner's Testing Agency to ensure the proper clearances have been maintained and that all reinforcement and inserts are firmly tied to resist displacement.
- B. The Owner's Testing Agency will inspect
 - 1. In-place reinforcing steel
 - 2. Field welding of reinforcing steel

3.5 Notification: Notify the Architect two working days in advance of concrete placement.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART I – GENERAL

1.1 Description of Work

- A. Work under this Section includes the furnishings and installing of all concrete work, complete, with all related accessories, items and incidentals required.
- B. Coordinate installation of all inserts and embedded items required or indicated.

1.2 Applicable Standards (latest editions apply)

- A. ACI- American Concrete Institute:
 - 1. 301, Specifications for Structural Concrete for Buildings.
 - 2. 305, Recommended Practice for Cold Weather Concreting.
 - 3. 306, Recommended Practice for Hot Weather Concreting.
 - 4. 318, Building Code Requirements for Reinforced Concrete.
- B. ASTM- American Society of Testing and Materials, Referenced Standards.
- C. ICC- International Code Council:
 - 1. CBC - 2013 California Building Code (California Code of Regulations, Title 24, Part 2)

1.3 Submittals

- A. Mix Design and Tests:
 - 1. Submit mix designs and compressive strength test reports from previous applications for specified types of concrete.
 - 2. One copy of all test reports shall be forwarded to DSA, the Architect, the Structural Engineer, the Inspector of Record within fourteen days of the test. Test reports shall comply with all requirements of CCR Title 24, Part 1, Section 4-335.

3. The concrete mixes shall be based on designs of a professional testing laboratory, verified by test, also in accordance with CBC Section 1905A.3 or 1905A.4.

PART II – PRODUCTS

2.1 Materials

- A. General: Materials for cast-in-place concrete shall be set as forth in ACI 301 except as modified herein and as otherwise indicated in project documents.
- B. Portland Cement: ASTM C150 Type II modified, with maximum alkali content of 0.6 percent (from only one source). Comply with Title 24, Section 1903A. Test cement per Title 24, Section 1916A
- C. Aggregates: ASTM C33, (from source as approved by the Testing Agency). Comply with Title 24, Section 1903A.3
- D. Water: clean, potable, free of injurious materials.
- E. Admixtures: Only brand products documented to have had not less than five years of satisfactory performance shall be used. Admixtures containing chlorides shall not be used. Comply with Title 24, Section 1904A and ACI-318, Section 3.6.
 1. Air Entraining: ASTM C260
- F. Grout: Manufactured pre-mixed. Non-ferrous, non-staining, flowable grout which will not shrink as it cures, 5000 psi @ 7 days.
- G. Fly Ash: Shall conform to CBC Section 1903A.5

2.2 Concrete Mix

- A. Ready-Mix Concrete: ASTM C94.

2.3 Proportion and Mixture

- A. Proportioning mixtures and production of concrete shall be in accordance with CBC, Section 1905A.2 and shall be in accordance with mix designs submitted by Laboratory and approved by the Owner's Testing Agency. All concrete shall have at least 5 sacks of cement per cubic yard of mix.
- B. Concrete shall have 3% +/- 1%, air entrainment when approved by Testing Agency.

- C. Water reducing admixtures may be used in concrete when approved by Testing Agency. Such admixtures shall not interfere with or reduce required air content dosage of air-entrained concrete.
- D. Use a minimum of 5 sacks of cement per cubic yard for all concrete.
- E. Concrete Mix Requirements: The following table presents a schedule of elements of concrete, compressive strength in psi after 28-days when tested in accordance with ASTM C39, maximum aggregate and maximum slump, which shall be as follows:

Concrete Element	Strength	Max. Size Aggregate (Inch)	Max. Slump (Inch)
All Concrete	per drawings	Per drawings	per drawings

PART III – EXECUTION

3.1 Inspection

- A. Areas in which concrete is to be placed shall be inspected by Contractor for defects which would prohibit satisfactory placement of concrete or related miscellaneous items. Such defects shall be corrected prior to commencement of work.
- B. Concrete shall not be deposited or placed until all forms, reinforcing steel and construction joints have been inspected by Owner’s Testing Agency and accepted in advance within the entire extent of the pour. Architect shall be notified 48 hours prior to first pour.

3.2 Field Quality Control

- A. The Owner’s Testing Agency will:
 1. Review concrete mix designs.
 2. Perform testing in accordance with ACI 318 and CBC Sections: 1903A and 1905A and 1916A.
 3. Continuously monitor concrete temperature and inspect concrete placement.
 4. Test concrete to control slumps according to ATSM C31 and ASTM C172.
 5. Test concrete for required compressive strength in accordance with CBC Section 1905A.6:

- a. Make and cure three specimen cylinders according to ATSM C31 for each 50 cubic yards per CBC 1905A.6.1, or fraction thereof, of each class poured at site each day.
- b. Retain one cylinder for 7-day test and two for the 28-day test.
- c. Number each cylinder 1A, 1B, 1C, 2A, 2B, 2C, etc; date each set; and keep accurate record of pour each set represents.
- d. Transport specimen cylinders from job to laboratory after cylinders have cured for 24-hours on site. Cylinders shall be covered and kept at air temperatures between 60 and 80 degrees Fahrenheit.
- e. Test specimen cylinders at age 7-days and age 28-days for specified strength according to ASTM C39.
- f. Base strength value on average of two cylinders taken for 28-day test.

B. The Contractor shall:

1. Submit ticket for each batch of concrete delivered to job site. Ticket shall bear the following information:
 - a. Design mix number.
 - b. Signature or initials of ready mix representative.

C. Comply with Title 24, CBC Section 1905A

3.3 Workmanship

A. All concrete shall be placed, finished and cured, and all other pertinent construction practices shall be in accordance with the Specifications for Structural Concrete for Buildings (ACI 301) hereby made a part of these specifications.

B. In addition to the requirements of ACI 301, the following shall prevail:

1. Concrete shall be placed so that a uniform appearance of surface will be obtained.
2. The concrete shall be free of all rock pockets, honeycombs and voids.
3. Concrete shall be deposited as nearly as practical in its final position.
4. The sub-grade shall be slightly moist when the concrete is placed for floor slabs to prevent excessive loss of water from the concrete mix.

5. Place concrete within 90 minutes of mixing.

C. Vibrators and Vibrating:

1. Employ as many vibrators and tampers as necessary to secure the desired results. Minimum: one per each 20 cubic yards of concrete placed per hour.

2. Eliminate the following applications:

a. Pushing of concrete with vibrator.

b. External vibration of forms.

c. Allowing vibrator to vibrate against reinforcing steel where steel projects into green concrete.

d. Allowing vibrator to vibrate contact faces of forms.

3. Vibrators shall function at a minimum frequency of 3600 cycles per minute when submerged in concrete.

4. Supplement vibration by forking and spading along the surfaces of the forms and between reinforcing whenever flow is restricted.

D. Curing:

1. General: Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and shall be maintained with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete. Also comply with CBC Section 1905A.11.

2. Initial Curing: Initial curing shall immediately follow the finishing operation. Concrete shall be kept continuously moist at least over night. One of the following materials or methods shall be used:

a. Ponding or continuous sprinkling.

b. Absorptive mat or fabric kept continuously wet.

3. Final Curing: Immediately following the initial curing and before the concrete has dried, additional curing shall be accomplished by one of the following materials or methods:

a. Continuing the method used in initial curing.

- b. Slabs to receive finish flooring materials to be continuously wet cured for 7 days.
 - c. Waterproof paper conforming to "Specifications for Waterproof Paper for Curing Concrete" (ASTM C171).
 - d. Curing compounds conforming to "Specifications for Liquid Membrane-Forming Compounds for Curing Concrete" (ASTM C309). Such compounds shall be applied in accordance with the recommendations of the manufacturer and shall not be used on any surfaces against which additional concrete or other cementitious finishing materials (such as ceramic tile) are to be bonded, nor on surfaces on which such curing is prohibited by the project specifications.
 - e. Other moisture-retaining coverings as approved.
4. Duration of Curing: The final curing continue until the cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the air in contact with the concrete is above 50 degrees F., has totaled 7 days.
 5. Formed Surfaces: Steel forms heated by the sun and all wood forms in contact with the concrete during the final curing period shall be kept wet. If forms are to be removed during the curing period, one of the above curing materials or methods shall be employed immediately. Such curing shall be continued for the remainder of the curing period.

E. Construction Joints

1. Joints not shown on the drawing shall be so made and located as to least impair the strength of the structural element and shall be approved by the Owner and Structural Engineer.
2. The surfaces of all concrete at all joints shall be thoroughly cleaned and all laitance removed by sandblasting.
3. Concrete surfaces at designated joints shall be roughened to ¼" relief with roto hammer or similar method.
4. Moisten all joints immediately prior to placement of concrete.

F. Embedded Items:

1. All sleeves, inserts, anchors and embedded items required for adjoining work or for its support shall be placed prior to concreting. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves,

inserts and anchor bolt slots shall be filled temporarily with a readily removable material to prevent entry of concrete into the voids.

G. Grouting Column Bases:

1. The grout shall be mixed and placed in strict accordance with manufacturer's instructions.
2. Care shall be taken in the grouting to insure that there is full bearing between the base plates and the grout.

3.4 Defective Work: Work considered to be defective may be ordered to be replaced, in which case the Contractor shall remove the defective work at his expense. Work considered to be defective shall include, but not be limited to, the following:

- A. Concrete in which defective or inadequate reinforcing steel has been placed.
- B. Concrete incorrectly formed, or not conforming to details and dimensions on the drawings or with the intent of these documents, or concrete the surfaces of which are out of plumb or level.
- C. Concrete below specified strength.
- D. Concrete containing wood, cloth or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the drawings.

3.5 Correction of Defective Work

- A. The Contractor shall, at his expense, make all such corrections as directed by the engineer.
- B. Concrete work containing rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the drawings shall be chipped out until all unconsolidated material is removed.

3.6 Slab Finish

- A. Covered interior slabs shall receive a smooth, steel troweled finish. Tolerance shall be 1/8" in 10'-0".
- B. Slabs under ceramic tile shall receive a roughened finish.
- C. Exposed interior & exterior slabs receive a broom finish as directed. Edges shall be smooth troweled. See drawings for specifics.

END OF SECTION

SECTION 26 00 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

- A. Refer to Division 0, the General Conditions, Supplementary Conditions and Division I - General Requirements, and the drawings. The Contractor, shall read the conditions and be responsible for, and governed by, all requirements thereunder. This Condition applies to all Sections of Specification Division 26.

1.2 REGULATIONS

- A. The Contractor shall give required notices to the building inspectors, the Engineer and the Owner and comply with laws, ordinances, rules and regulations applicable to the work and safety. Authorities include, but are not limited to:
 - 1. The latest revision of the State of California Electrical Code.
 - 2. The applicable Rules and Regulations of the National Fire Protection Association.
 - 3. State Fire Marshal.
 - 4. Underwriters Laboratories.
 - 5. Any other applicable Federal, State, County or City Codes or Regulations, including O.S.H.A.
- B. Nothing in these Drawings or Specifications shall be construed to permit work not conforming to the above Regulations and Codes.

1.3 DRAWINGS AND SPECIFICATIONS

- A. Drawings are diagrammatic and indicate the general arrangement of equipment and wiring. Exact requirements shall be governed by the engineer, structural and mechanical conditions of the job. Consult other drawings in preparation of the bid. As-built record drawings
- B. Extra lengths of wiring or pull boxes or junction boxes, etc., necessitated by the existing conditions shall be included in the bid. Report any apparent discrepancies before submitting bid.
- C. Right is reserved by the Engineer to make changes of up to ten feet in location of any outlet or equipment prior to roughing-in without increasing contract cost.

1.4 EXAMINATION OF SITE

- A. The Contractor shall examine the site and the existing conditions and make allowances for them in preparing his proposal. In the event of discrepancies between existing conditions and the Drawings, the Contractor shall report such discrepancies prior to bid and bid the

conditions necessary to complete the job and to provide a fully operable and acceptable systems.

- B. Extra charges will not be allowed for work that must be provided when it was apparent from a pre-bid inspection of the premises, even though the work is not shown on the drawings or called for in the Specification.

1.5 RECORD DRAWINGS AND SYSTEM OPERATION AND MAINTENANCE

- A. Refer to Division 1 Sections "Closeout Procedures", "Operation and Maintenance Data", "Project Record Documentation" and "Demonstration and Training".

1.6 SHOP DRAWING AND MATERIAL LIST

- A. Refer to Division 1 Sections "Submittal Procedures".

1.7 OPERATING AND MAINTENANCE MANUALS

- A. Refer to Division 1 Sections "Operation and Maintenance Data".

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Receive, store and handle materials in a manner to prevent damage. Costs of damage shall be borne by the Contractor.
- B. Protect equipment from weather (rain, sunshine, winds), water vapors, theft, and vehicular traffic.

PART 2 - PRODUCTS

2.1 MATERIAL APPROVAL

- A. The design, manufacture and testing of electrical equipment and materials shall conform to or exceed latest applicable NEMA, IEEE, ANSI, and U.L. Standards.
- B. Materials shall be new and bear Underwriters Laboratories (UL) label or other accepted testing laboratory certification. Materials that are not labeled by U.L. shall be tested and approved by an independent testing laboratory or a governmental agency acceptable to the Engineer, Owner and code enforcing authority.

PART 3 - EXECUTION

3.1 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

- A. Installation of parts and connection of parts into systems shall be completed by skilled electrical journeymen. Material assemblies and installation work shall meet applicable code requirements, be securely fastened to structure, attractive in appearance and safe to operate. Provide code required clearance about electrical equipment. Assembly work or installations

that are improper, unsafe or unattractive shall be removed and replaced with satisfactory work at no additional cost to the Owner.

- B. Provide an on site foreman or superintendent in charge of this work at all times.

3.2 COORDINATION

- A. Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished by other trades. Inform other trades Sub-contractors of the required access to, and clearances around, electrical equipment to maintain serviceability and code compliance.
- B. Verify equipment dimensions and requirements. Check actual job conditions before installing work. Report necessary changes in design to the Engineer in time to prevent needless work. Changes, or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

3.3 MANUFACTURER'S INSTRUCTIONS

- A. Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall at all times be kept in the job superintendent's office and shall be available to the Engineer and Owner's representative.
- B. Follow manufacturer's instructions where they cover points not specifically indicated on drawings and specifications. If instructions are in conflict with the drawings and specifications, obtain clarification from the Engineer before starting work.

3.4 QUALITY ASSURANCE

- A. Provide a Quality Assurance program. These specifications set forth the minimum acceptable requirements. The specifications do not prohibit the Contractor from executing other Quality Assurance measures which can improve the operating facility, improve the construction schedule, and conserve energy within the scope of this project.
- B. The Contractor shall insure that workmen's practices, materials employed, equipment and methods of installation conform to accepted construction and engineering practices, and that each piece of equipment can satisfactorily perform its functional operation.

3.5 CLOSING IN UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested and/or approved. Field observations made by the engineer do not waive the inspections required by the contract documents.
- B. Should a portion of the work be enclosed or covered up prior to inspection and testing, the contractor shall uncover the work at his own expense, and after it has been tested, inspected

and approved, make repairs with such materials as may be necessary to restore the uncovered work to its intended condition.

3.6 PRELIMINARY OPERATION

- A. Should the Owner request that a portion of the plant, apparatus or equipment be operated prior to final completion and acceptance of the work, the Contractor shall consent, and such operation shall be under the supervision and direction of the Contractor, but expense thereof shall be paid by the Owner, separate and distinct from money paid on account of the Contract. Such preliminary operation and payment thereof shall not be construed as an acceptance of that portion of the work in this Contract.

3.7 ACCEPTANCE DEMONSTRATION

- A. Refer to Division 1 Section "Demonstration and Training".
- B. The system demonstrations shall be made by this Contractor in the presence of the Engineer and the manufacturer's representative.
- C. Demonstrate the function (in the structure) of each system and indicate its relationship to the single line diagrams and drawings.
- D. Demonstrate by "start-stop operation", the controls, how to reset protective devices, how to replace fuses and what to do in case of emergency.
- E. Demonstrate how maintenance and spare parts manuals are related to the equipment and systems installed.

3.8 TESTS

- A. Where the Contract Documents, laws, ordinances or any public authority requires any work to be tested specifically or reviewed by another authority, the Contractor shall give the Engineer/Owner timely notice of readiness therefor. The Contractor shall give the Engineer/Owner the test results for review. If any work to be tested is covered up without written approval or consent of the Engineer, it must, if directed by the Engineer, be uncovered for examination at the Contractor's expense.
- B. The cost of all such tests shall be borne by the Contractor.
- C. Any work which fails to meet the requirements of any test or any work which does not meet the requirements of the Contract Documents shall be considered defective and may be rejected. Rejected work shall be corrected promptly by the Contractor or removed from the site.
- D. Provide written test reports for each test to the Engineer for review.

END OF SECTION 26 00 00

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SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Supporting devices for electrical components.
 - 2. Cutting and patching for electrical construction.
 - 3. Touchup painting.

1.3 COORDINATION

- A. Coordinate conduits, cable pathways, chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure to maintain existing components and operations to facilitate the electrical installations.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment, anchorage and logistics with the ongoing campus and building operations.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch diameter slotted holes at a maximum of 2 inches o.c., in webs.
 - 1. Channel Thickness: Selected to suit structural loading.
 - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.

- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers and J-hooks.
- E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- F. Expansion Anchors: Carbon-steel wedge or sleeve type.
- G. Toggle Bolts: All-steel springhead type.

2.2 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate operation service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations or existing conditions.
- D. Right of Way: Give to raceways and piping systems installation.
- E. Coordination: Coordinate with work existing conditions, ongoing campus and building operation, other trades, especially other utilities routes and clearances required to properly provide work.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.

3.3 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze or bracket-type hangers.
- D. Size supports for multiple raceway installations, so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceways with an approved fastener not more than 24-inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
 - 1. Wood: Fasten with wood screws, screw-type nails or lag bolts.

2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Steel: Welded threaded studs or spring-tension clamps on steel.
 - a. Field Welding: Comply with AWS D1.1.
6. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
7. Light Steel: Sheet-metal screws.
8. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

3.5 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new firestopping where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.6 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
 1. Supporting devices for electrical components.
 2. Electrical demolition.
 3. Cutting and patching for electrical construction.
 4. Touchup painting.

3.8 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touchup paint.
 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

B. Remove and replace with new items damaged beyond repair or refinishing.

3.9 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations, and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of completion.

END OF SECTION 26 05 00

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SECTION 26 05 23

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality-Control Test Reports: From a qualified testing and inspecting agency engaged by Contractor.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
 - 1. American Insulated Wire Corp.; a Leviton Company.
 - 2. General Cable Corporation.
 - 3. Okonite Wire & Cable Company.
 - 4. Southwire Company.

- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material: Copper complying with NEMA WC 5; stranded conductor.
- D. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Hubbell/Anderson.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.
 - 5. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Concrete and Below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- D. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

3.2 INSTALLATION

- A. All 120V power conductors and cables shall be installed in raceways.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Seal around conduits penetrating fire-rated elements to maintain fire rating integrity.
- E. Low voltage open cable installed above accessible ceiling space shall be supported by metallic J-hooks. No stapling is allowed. Staples used shall be removed and cable conductivity shall be tested by contractor at contractor's cost.

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 23

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SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Fittings.
- B. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors, Cables, Connectors, and Rods:

- a. Apache Grounding/Erico Inc.
- b. Chance/Hubbell.
- c. Copperweld Corp.
- d. Erico Inc.; Electrical Products Group.
- e. Framatome Connectors/Burndy Electrical.
- f. Galvan Industries, Inc.
- g. Ideal Industries, Inc.
- h. ILSCO.
- i. Kearney/Cooper Power Systems.
- j. Korns: C. C. Korns Co.; Division of Robroy Industries.
- k. O-Z/Gedney Co.; a business of the EGS Electrical Group.
- l. Raco, Inc.; Division of Hubbell.
- m. Superior Grounding Systems, Inc.
- n. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Grounding Electrode Conductors: Stranded cable.

D. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

E. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

F. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated on the drawings.

3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and branch circuits.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- D. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, MDF/IDF, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations, MDF/IDF, and Wiring Closets: Terminate grounding conductor on a ¼" thick x 2" x 12" grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION 26 05 26

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SECTION 26 05 33

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Divisions 26 and 27 Section "Basic Electrical Materials and Methods", "Wiring Devices", "Communication System", supports, anchors, and identification products.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

- A. Product Data: For conduit, fittings, surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with existing conditions and work of other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

- A. Available Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 6. LTV Steel Tubular Products Company.
 - 7. Manhattan/CDT/Cole-Flex.
 - 8. O-Z Gedney; Unit of General Signal.
 - 9. Wheatland Tube Co.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Compression type.
- E. FMC: Aluminum.
- F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. Available Manufacturers:
 - 1. American International.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arco Corp.
 - 4. Cantex Inc.
 - 5. Carlon.
 - 6. Certainteed Corp.; Pipe & Plastics Group.
 - 7. Condux International.

8. ElecSYS, Inc.
9. Electri-Flex Co.
10. Lamson & Sessions; Carlon Electrical Products.
11. Manhattan/CDT/Cole-Flex.
12. RACO; Division of Hubbell, Inc.
13. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Available Manufacturers:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color - color to match adjacent finish colors.

1. Manufacturers:

- a. Walker Systems, Inc.; Wiremold Company (The).
- b. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. Emerson/General Signal; Appleton Electric Company.
 3. Erickson Electrical Equipment Co.
 4. Hoffman.
 5. Hubbell, Inc.; Killark Electric Manufacturing Co.
 6. O-Z/Gedney; Unit of General Signal.
 7. RACO; Division of Hubbell, Inc.
 8. Robroy Industries, Inc.; Enclosure Division.
 9. Scott Fetzer Co.; Adalet-PLM Division.
 10. Spring City Electrical Manufacturing Co.
 11. Thomas & Betts Corporation.
 12. Walker Systems, Inc.; Wiremold Company (The).
 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- D. Floor Boxes: Cast metal, fully adjustable, rectangular. Walker Omni box, RFB 4 or equal as indicated.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.7 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors:
1. Exposed: Rigid steel or IMC.
 2. Concealed: Rigid steel or IMC.
 3. Underground, Single Run: RNC.

4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

- a. Damp or Wet Locations: NEMA 250, Type 4.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 26 Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

- H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in concrete.
 - 3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 4. Change from rigid nonmetallic conduit to rigid steel conduit or IMC before rising above the floor.
- I. Raceways below Slabs: Install in base rock below slab where practical and leave at least 2 inches of base rock cover.
- J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- K. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- L. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 18 inches of slack at each end of pull wire.
- N. Telephone and Signal System Raceways, 2 Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6

inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

- P. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- Q. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- R. Set floor boxes level and flush with finished floor surface.
- S. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- B. Remove and replace with new any item damaged beyond repair or refinishing.

3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

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SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 0 General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

- A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
 - 1. Color: Black letters on orange field.
 - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.
- D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- E. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.

- 4. Printed legend indicating type of underground line.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Brass or Aluminum Tags: 2 by 2 by 0.05 inch metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
 - 1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
 - 2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
 - 3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
 - 4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Install painted identification according to manufacturer's written instructions and as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime surfaces using type of primer specified for surface.
 - 3. Apply one intermediate and one finish coat of enamel.
- F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- G. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 12 inches below finished grade. Where width of multiple lines installed in a common trench does not exceed 16 inches overall, use a single line marker.
- H. Color-Coding of Secondary Phase Conductors: Use the following colors for phase conductors:
 - 1. 208/120-V Conductors:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White
 - e. Ground: Green.
 - 2. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG.
 - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-

inch wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

- b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
- I. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
 1. Legend: 1/4 inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
 - J. Apply identification to conductors as follows:
 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
 - K. Apply warning, caution, and instruction signs as follows:
 1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 - L. Device Identification Labels: Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating. Install on each device cover of power receptacles, switches and tele/data outlets with feeder source (i.e. panelboard, MDF, IDF) and circuit number information.
 - M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Branch feeder breakers at switchboard and distribution panel.
2. Enclosed circuit breakers.
3. Telephone switching equipment.

END OF SECTION 26 05 53

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SECTION 26 22 00

DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes dry-type distribution and specialty transformers rated 1000 V and less.

1.3 SUBMITTALS

- A. Product Data: Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
- B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.
- C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.
- D. Factory Test Reports: Certified copies of manufacturer's design and routine factory tests required by referenced standards.
- E. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.
- F. Maintenance Data: For transformers to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to requirements specified in Division 1 Section "Quality Requirements," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the InterNational Electrical Testing Association.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.

- B. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- C. Comply with IEEE C2.
- D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide transformers by one the following:
 - 1. Acme Electric Corp.; Transformer Division.
 - 2. Bryant Electric.
 - 3. Cutler-Hammer/Eaton Corp.
 - 4. Federal Pacific Co.; Line Power Mfg. Corp. Subsidiary.
 - 5. GE Electrical Distribution & Control.
 - 6. Hammond Co.; Matra Electric, Inc.
 - 7. MagneTek Inc.
 - 8. Micron Industries Corp.
 - 9. Sola/Hevi-Duty Electric.
 - 10. Square D; Groupe Schneider.

2.2 TRANSFORMERS, GENERAL

- A. Description: Factory-assembled and -tested, air-cooled units of types specified, designed for 60-Hz service.
- B. Cores: Grain-oriented, nonaging silicon steel.
- C. Coils: Electrical grade aluminum. Continuous windings without splices, except for taps.
- D. Internal Coil Connections: Brazed or pressure type.
- E. Enclosure: Class complies with NEMA 250 for the environment in which installed.

2.3 GENERAL-PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

- A. Comply with DOE 2016 and ST-20 and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Windings: One coil per phase in primary and secondary.
- D. Enclosure: Indoor, ventilated, drip-proof.
- E. Insulation Class: 220 deg C.
 - 1. Rated Temperature Rise: 150 deg C maximum rise above 40 deg C, for 220 deg C class insulation.
- F. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings are as follows:
 - 1. Taps, 25 kVA and Above: Four 2.5-percent taps, 2 above and 2 below rated high voltage.
- G. K-Factor Rating: Transformers indicated to be K-factor rated are listed to comply with UL 1561 requirements for nonsinusoidal load current handling capability to the degree defined by the designated K-factor.
 - 1. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor.
 - 2. Nameplate states the designated K-factor of the transformer.

2.4 CONTROL AND SIGNAL TRANSFORMERS

- A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.
- B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.
- C. Description: Self-cooled, 2 windings.

2.5 FINISHES

- A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

2.6 SOURCE QUALITY CONTROL

- A. Factory Tests: Design and routine tests comply with referenced standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with safety requirements of IEEE C2.
- B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.
- C. Identify transformers and install warning signs according to Division 26 Section "Electrical Identification."
- D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.2 GROUNDING

- A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes.
- B. Comply with Division 26 Section "Grounding and Bonding" for materials and installation requirements.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.
- B. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing.
- C. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed "Satisfactory Test" label to tested component.
- D. Schedule tests and provide notification at least 7 days in advance of test commencement.
- E. Report: Submit a written report of observations and tests. Report defective materials and installation.
- F. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.
 - 1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A.
 3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
 - a. Minimum Test Voltage: 1000 V, dc.
 - b. Minimum Insulation Resistance: 500 megohms.
 - c. Duration of Each Test: 10 minutes.
 - d. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.
- G. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.4 CLEANING

- A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5 ADJUSTING

- A. After installing and cleaning, touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

END OF SECTION 26 22 00

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.
- B. Related Sections include the following:
 - 1. Division 26 Section 26 05 73 - Overcurrent Protective Device Coordination.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
 - F. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1.
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corp.; Cutler-Hammer Products.

- b. General Electric Co.; Electrical Distribution & Control Div.
- c. Industrial Electric Manufacturing (IEM).
- d. Square D Co.

2.2 FABRICATION AND FEATURES

- A. Enclosures: Flush and surface mounted cabinets. NEMA PB 1, Type 1, to meet environmental conditions at installed location.
- B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
- D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.
- E. Bus: Hard-drawn copper, 98 percent conductivity.
- F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- H. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- I. Isolated Equipment Ground Bus Where Indicated: Adequate for branch-circuit equipment ground conductors; insulated from box.
- J. Extra-Capacity Neutral Bus Where Indicated: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- K. Feed-through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. UL label indicating series-connected rating with integral or remote upstream devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike to Owner's standard.

2.5 DISTRIBUTION PANELBOARDS

- A. Main Overcurrent Protective Devices: Circuit breaker.
- B. Branch overcurrent protective devices shall be bolt-on type.

2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
 - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Circuit Directory: Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Provide temporary panel schedule during construction, handwritten directories are acceptable. Use a computer or typewriter to create the permanent directory at each panel.
- E. Install filler plates in unused spaces.

- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification".
- B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

- A. Safe off power source prior to connection of power panel.
- B. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:
 - 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges according to the coordination report per Division 26 Section "Overcurrent Protective Device Coordination".

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.
- B. Remove and replace with new any item damaged beyond repair or refinishing.

END OF SECTION 26 24 16

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

- 1. Motor and equipment disconnecting means.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for components.
 - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - 3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA AB 1 and NEMA KS 1.
- D. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fusible Switches:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Square D Co.
 2. Molded-Case Circuit Breakers:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Square D Co.
 3. Combination Circuit Breaker and Ground-Fault Trip:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Square D Co.
 4. Molded-Case, Current-Limiting Circuit Breakers:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Square D Co.

5. Integrally Fused, Molded-Case Circuit Breakers:
 - a. Eaton Corp.; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Control Division.
 - c. Square D Co.

2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5mA trip sensitivity.
 7. Molded-Case Switch: Molded-case circuit breaker without trip units.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.5 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification".
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 - 2. Test continuity of each line- and load-side circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 28 16

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SECTION 26 32 13

PACKAGED ENGINE GENERATOR

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes packaged diesel-engine generator sets with the following accessory features.
 - 1. Battery charger.
 - 2. Engine/Generator set.
 - 3. Special application super critical grade muffler.
 - 4. Weatherproof sound attenuating enclosure.
 - 5. Control panel emergency stop push button
 - 6. Starting battery.
 - 7. Active particulate matter filter
 - 8. Fuel recirculation system and controls
 - 9. Remote annunciator
 - 10. Dual-wall sub-base fuel tank
 - 11. Load center for generator auxiliary loads.
 - 12. Generator and load bank breakers
 - 13. UL 2200 listed.
- B. See Division 26 Section "Transfer Switches" for transfer switches, containing sensors and relays to initiate automatic starting and stopping.
- C. BAAQMD (Bay Area Air Quality Management District) permit, Hazardous Material inspections and testing will be acquired by the County.

1.02 SUBMITTALS

- A. Product Data: For the generator set and each accessory component indicated.
- B. Shop Drawings: Include plans, elevations, sections, details of installation, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Certified prototype test reports.
- D. Field quality-control test reports.
- E. Operation and maintenance data.
- F. Submit study by an acoustical consultant showing compliance with Count of Santa Clara Zoning Ordinance noise standards.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of emergency maintenance and repairs at the Project with eight hours' maximum response time and 24-hour service availability.
- B. Source Limitations: Obtain packaged engine generator and auxiliary components specified in this Section through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All clearance around the electrical equipment shall be in compliance with the California Electrical Code and all local jurisdiction requirements.
- D. Comply with NFPA 70.
- E. Comply with NFPA 110 requirements for Level 1 stand-by power supply system.
- F. Noise Emission: Comply with applicable state and local government requirements. Unit shall be provided with a sound attenuated enclosure reducing the noise generated during operation to 80dBA at 23 feet or better.
- G. Comply with CARB (California Air Resources Board) air regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Caterpillar, Cummins, Kohler or approved equal. Refer to drawing for generator size.

2.02 ENGINE GENERATOR SET

- A. Provide a coordinated assembly of compatible components.
- B. Safety Standard: Comply with ASME B15.1.
- C. Nameplates: Each major system component is equipped with a conspicuous nameplate of component manufacturer. Nameplate identifies manufacturer of origin and address, and model and serial number of item.
- D. Provide steel skid with grounding lug. Provide spring-type vibration isolators.
- E. 80-degree C rated alternator.
- F. Gen-set shall have active particulate matter filter and enclosure, Cleare Bug trap.
- G. Oil drain extension, coolant drain extension.

2.03 GENERATOR-SET PERFORMANCE

- A. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
- B. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
- C. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage recovers to remain within the steady-state operating band within three seconds.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within five seconds.
- G. Output Waveform: At no load, harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.
- H. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.04 SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator shall be equipped to start and operate satisfactorily under the following environmental conditions without mechanical or electrical damage or deg radiation of performance capability:
 - 1. Ambient Temperature: 35 deg C.
 - 2. Altitude: 2100 ft elevation
 - 3. Seismic Zone: D

2.05 ENGINE

- A. Description: 4-cycle unit with maximum piston speed of 1596 fpm.
- B. Engine shall comply with BAAQMD regulations and EPA certified Tier 3 requirements.
- C. Fuel: Ultra Low Sulfer No. 2 Diesel
- D. Rated Engine Speed: 1800 rpm.

- E. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps or siphons or special tools or appliances.
- F. Engine Fuel System: Comply with NFPA 37. System includes the following:
 - 1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 - 2. Relief/Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- G. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment.
- H. Factory-installed vertical-discharge radiator shroud.

2.06 GOVERNOR

- A. Type: Electronic, adjustable isochronous, with speed sensing. Governor and generator controls shall start and connect the generator system in less than 10 seconds.

2.07 ENGINE COOLING SYSTEM

- A. Description: Closed loop, liquid cooled, with radiator factory mounted on engine generator-set skid and integral engine-driven coolant pump.
 - 1. Radiator Core Tubes: Nonferrous-metal construction other than aluminum.

2.08 FUEL SUPPLY SYSTEM

- A. Comply with NFPA 30 and NFPA 37.
- B. Base-Mounted Fuel Oil Tank: Factory-installed and -piped, listed unit. Features include the following:
 - 1. Fuel level indicator.
 - 2. Capacity: 24 hour dual wall integral fuel tank, UL 142 (File No. MH25524) compliant/labeled, Contra Costa County Code compliant,
 - 3. Manual fuel fill with vandal-resistant fill cap.
 - 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
 - 5. Overfill containment.
 - 6. Fuel tank shall be provided with permanently affixed UL label, fuel transfer pump, fuel tank controls, normal and emergency vents, vent valves and vent extensions as required.
 - 7. Fuel tank leak detection and alarm system shall be provided with two float switch assemblies, one multilevel (4) in the primary tank and one single level in secondary containment. The high/high approx. 90 %, low approx. 15% switches and the float switch in the secondary containment shall be connected to generator control panel for annunciation (visual and audible).

- C. Unit also equipped with recirculation system as well.

2.09 ENGINE EXHAUST SYSTEM

- A. Muffler: Special application super critical grade, sized as recommended by engine manufacturer. Measured sound level at a distance of 6 feet from exhaust discharge, is 50 dBA or less.
- B. Condensate Drain for Muffler: Schedule 40, black steel pipe connected to muffler drain outlet through a petcock.
- C. Connections from Engine to Exhaust System: Flexible section of corrugated stainless-steel pipe.
- D. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.*
- E. Supports for Muffler and Exhaust Piping: Spring hangers and all-thread rods and vibration hangers.
- F. Exhaust Piping External to Engine: ASTM A 53, 1 ¼" Schedule 40, welded, black carbon steel, with welded joints and fittings. Venting capacity shall be 84, 200 CFH. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation and joint construction.
- G. Normal venting caps shall be 1 ¼" screened mushroom type. Emergency venting caps shall be 4" by tank manufacturer. Venting capacity for the venting caps shall be 84,200 CFH.
- G. Provide exhaust rain cap and shield.

2.10 COMBUSTION-AIR-INTAKE

- A. Description: Heavy-duty, engine-mounted air cleaner with replaceable dry filter element and "blocked filter" indicator.

2.11 STARTING SYSTEM

- A. Description: 12-V electric, with negative ground and including the following items:
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 - 4. Battery: Adequate capacity within ambient temperature range specified in "Environmental Conditions" Paragraph in "Service Conditions" Article above to provide specified cranking cycle at least twice without recharging.

5. Battery Cable: Size as recommended by generator-set manufacturer for cable length and battery capacity indicated. Include interconnecting conductors and connection accessories.
6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit complies with UL 1236 and includes the following features:
 - a. Operation: Equalizing-charging rate of 10 A is initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit then automatically switches to a lower float-charging mode and continues operating in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Adjusts float and equalizes voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Ammeter indicates charging rate.
 - e. Safety Functions: Include sensing of abnormally low battery voltage, arranged to close contacts providing low battery voltage indication on control and monitoring panel. Also include sensing of high battery voltage and loss of ac input or dc output of battery charger. Either of latter conditions closes contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Battery charger shall be located in the automatic transfer switch housing for vibration protection.

2.12 DIGITAL MICROPROCESSOR CONTROL AND MONITORING

- A. Functional Description: When the mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator-set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shut down the generator set and initiate alarms.
- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls: Include the following:
 1. AC voltmeter.
 2. AC ammeter.

3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gage.
 6. Engine lubricating-oil pressure gage.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator voltage adjusting rheostat.
 10. Test-stop-auto switch.
 11. Over-speed shutdown device.
 12. Coolant high-temperature shutdown device.
 13. Coolant low-level shutdown device.
 14. Oil low-pressure shutdown device.
 15. Fuel tank derangement alarm.
 16. Fuel tank high-level shutdown of fuel supply alarm.
 17. Low battery alarm.
 18. Fuel leak alarm.
 19. Generator overload.
- G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer's standard.
- H. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated.
- I. Common Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Locate audible device and silencing means at the control panel. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
 2. Lube-oil low-pressure shutdown.
 3. Over-speed shutdown.
 4. Remote emergency-stop shutdown.
 5. Engine high-temperature pre-alarm.
 6. Lube-oil low-pressure pre-alarm.
 7. Fuel tank low level.
 8. Over-crank shutdown.
 9. Coolant low-temperature alarm.
 10. Control switch not in auto position.
 11. Fuel leak alarm.
 12. Battery-charger malfunction alarm.
 13. Battery low-voltage alarm.

- J. Emergency-Stop Switch: Control panel genset-mounted. Push button is protected from accidental operation.
- K. Control Panel Anti-Condensation Heater and Thermostat.

2.13 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
 - 1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
 - 2. Trip Settings: Matched to generator thermal damage curve as closely as possible.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
 - 5. Load Bank Test Circuit Breaker.

2.14 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1 and specified performance requirements.
- B. Drive: Generator shaft is directly connected to engine shaft. Exciter is rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction prevents mechanical, electrical, and thermal damage due to vibration, over-speed up to 125 percent of rating, and heat during specified intervals of operation at 110 percent of rated capacity.
- F. Exciter: PMG (Permanent Magnet Generator) system excitation..
- G. Enclosure: Drip-proof.
- H. Voltage Regulator
 - 1. Integrated digital electronic voltage regulator
 - 2. 3-phase line to neutral sensing
 - 3. Single and three phase fault regulation
 - 4. Configure torque matching
- I. 80°C rise rated alternator with anti-condensation heater.

2.15 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple housing-access panels are lockable and provide adequate access to components requiring maintenance. Panels are removable by one person without tools. Instruments and controls are mounted within enclosure. Enclosure to provide sound attenuation of 50 dBA at 6 feet.
- B. Engine Cooling Airflow through Enclosure: Adequate to maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
- C. Louvers: Fixed-engine cooling air inlet and discharge. Louvers prevent entry of rain.
- D. Convenience Outlet: Factory wired. Arrange for external circuit supply.
- E. Enclosure shall NOT be yellow.

2.16 REMOTE ANNUNCIATOR

- A. Unit shall be indoor type, provide all the accessories as required including wiring between generator local annunciation and remote unit.

2.17 FINISHES

- A. Description: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.18 SOURCE QUALITY CONTROL

- A. Factory Tests: Include prototype testing and Project-specific equipment testing (testing of equipment manufactured specifically for this Project).
 - 1. Tests: Comply with those required for Level 1 energy converters in Paragraphs 3.2.1, 3.2.1.1, and 3.2.1.2 of NFPA 110.
- B. Project-Specific Equipment Tests: Factory test engine generator set and other system components and accessories before shipment. Perform tests at rated load and power factor. Include the following tests:
 - 1. Full load run.
 - 2. Maximum power.
 - 3. Voltage regulation.
 - 4. Transient and steady-state governing.
 - 5. Single-step load pickup.
 - 6. Safety shutdown.
 - 7. Sound/noise measurement test.

8. Fuel tank pressure test.
- D. Provide three (3) copies of the test reports to owner for review and acceptance.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with packaged engine generator manufacturers' written installation and alignment instructions, and with NFPA 110.
- B. Set packaged engine generator on concrete base. Cast-in-place concrete, reinforcement, and formwork.
 1. Support generator-set mounting feet on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide 3/4- to 1-1/2-inch gap between pump base and foundation for grouting.
 2. Adjust metal supports or wedges until generator is level.
- C. Install packaged engine generator to provide access for periodic maintenance without removing connections or accessories.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- E. Verify that electrical wiring is installed according to manufacturer's submittal and installation requirements. Proceed with equipment start up only after wiring installation is satisfactory.
- F. Provide and install California Seismic Zone 4 spring type vibration isolators.

3.02 IDENTIFICATION

- A. Identify system components according to Division 16 Section "Electrical Identification."

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to supervise testing. Report results in writing.
- B. Tests: Include the following:
 1. Tests recommended by manufacturer.
 2. International Electrical Testing Association Tests: Perform each visual and mechanical inspection and electrical and mechanical test stated in NETA ATS for emergency engine generator sets, except omit vibration baseline test. Certify compliance with test parameters for tests performed.

3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
 4. Single-step full-load pickup test.
 5. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.
 6. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 7. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator installation before and during system operation. Check for air, exhaust, and fluid leaks.
 8. Noise Level Tests: Measure A-weighted level of noise emanating from the generator-set installation, including engine exhaust and cooling air intake and discharge, at four locations on the property line and at locations directed by the acoustical consultant and compare measured levels with required values.
 9. On site fuel tank pressure test and AHU witness testing as required.
- C. Coordinate generator-set tests with tests for transfer switches and perform them concurrently.
- D. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Make calibration records available for examination on request.

3.04 BATTERY EQUALIZATION

- A. Description: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.
1. Coordinate with training requirements for transfer switch.
 2. Provide five (5) copies of printed training materials and two sessions of four (4) hour on site training.

END OF SECTION 26 32 13

SECTION 26 36 00

TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
 - 1. Automatic transfer switch.
 - 2. Bypass/isolation switch.
 - 3. Remote annunciation and control system.

1.3 SUBMITTALS

- A. Product Data: Include ratings and dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
- B. Wiring Diagrams: Detail wiring for transfer switches and differentiate between manufacturer-installed and field-installed wiring. Show both power and control wiring.
- C. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- D. Product Certificates: Signed by manufacturer certifying that products furnished comply with requirements and that switches have been tested for load ratings and short-circuit closing and withstand ratings applicable to units for Project.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- F. Field Test Reports: Indicate and interpret test and inspection results for compliance with performance requirements.
- G. Maintenance Data: For each type of product to include in maintenance manuals specified in Division 1. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing emergency maintenance and repairs at Project site with an eight-hour maximum response time.
- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies (Level 3 or higher), to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain automatic transfer and bypass/isolation switch, remote annunciator and control panels through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NEMA ICS 1.
- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008, unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Transfer Switches:
 - a. Cummins-Onan Corp.; Electrical Products Division or equal.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where Transfer Switch Includes Internal Fault-Current Protection: Rating of switch and trip unit combination exceeds indicated fault-current value at installation location.
- C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communications capability matched with remote device.
- D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- E. Resistance to Damage by Voltage Transients: Components meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- F. Neutral Terminal: Solid and fully rated, unless otherwise indicated.
- G. Enclosures: Mounted in the switchboard enclosure, complying with NEMA ICS 6; UL 508, unless otherwise indicated.
- H. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
 - 1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- J. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Switch Action: Double throw; mechanically held in both directions.

2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units rated 400 A and greater have separate arcing contacts.
- K. Provide WCR of transfer switch to match or exceed switchboard AIC rating.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is the same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Digital Communications Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.
- G. Automatic Transfer Switches: Include the following functions and characteristics:
 1. Open transient
 2. Load transfer, through time delay interconnection of both power sources
 3. Initiation Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

Initiation occurs without active control of generator set.

 - a. Controls ensure open-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees, maximum and plus or minus 5 percent maximum voltage difference.
 4. Failure of the power source serving the load initiates automatic break-before-make transfer.
- H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.4 AUTOMATIC TRANSFER-SWITCH FEATURES

- A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage is adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
- B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
- C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator set. Pickup voltage is adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency is adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
- D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes; factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
- E. Test Switch: Simulates normal-source failure.
- F. Switch-Position Pilot Lights: Indicate source to which load is connected.
- G. Source-Available Indicating Lights: Supervise sources via transfer-switch, normal- and emergency-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
- H. Unassigned Auxiliary Contacts: Two normally open single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
- I. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- J. Engine Starting Contacts: One isolated, normally closed and one isolated, normally open, rated 10 A at 32-V dc minimum.
- K. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes; factory set for five minutes. Initiates shutdown at remote engine-generator controls after retransfer of load to normal source.
- L. Battery charger shall be located and integral to transfer switch enclosure.
- M. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts

down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
2. Push-button programming control with digital display of settings.
3. Integral battery operation of time switch when normal control power is not available.

2.5 BYPASS/ISOLATION SWITCHES

- A. Comply with requirements for Level 1 equipment per NFPA 110.
- B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
 1. Means to lock bypass/isolation in the position that isolates transfer switch, with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
 2. Drawout Arrangement for Transfer Switch: Provides physical separation from live parts and accessibility for testing and maintenance operations.
 3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with the same phase arrangement and number of poles.
 4. Contact temperatures of bypass/isolation switches do not exceed those of automatic transfer-switch contacts when they are carrying rated load.
 5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less.
 6. Legend: Manufacturer's standard legend for control labels and instruction signs give detailed operating instructions.
 7. Maintainability: Fabricate to allow convenient removal of major components from the front without removing other parts or main power conductors.
- C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars, plated at connection points and braced for the indicated available short-circuit current.

2.6 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

- A. Functional Description: Include the following functions for indicated transfer switches:
 1. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
 2. Indication of switch position.

3. Indication of switch in test mode.
 4. Indication of failure of digital communications link.
 5. Key-switch or user-code access to control functions of panel.
 6. Control of switch-test initiation.
 7. Control of time-delay bypass for transfer to normal source.
 8. Ground fault monitoring.
- B. Malfunction of annunciator, annunciation and control panel, or communications link shall not affect functions of automatic transfer switch. In the event of failure of the communications link, automatic transfer switch automatically reverts to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
- C. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
1. Controls and indicating lights grouped together for each transfer switch and in compliance with NFPA 110.
 2. Label each indicating light control group. Indicate the transfer switch it controls, location of the switch, and the load it serves.
 3. Digital Communications Capability: Matched to that of transfer switches supervised.
 4. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

2.7 FINISHES

- A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer, NEMA 12 type.

2.8 SOURCE QUALITY CONTROL

- A. Factory Test Components, Assembled Switches, and Associated Equipment: Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- B. Identify components according to Division 16 Section "Basic Electrical Materials and Methods."
- C. Identify components according to Division 16 Section "Electrical Identification."

3.2 WIRING TO REMOTE COMPONENTS

- A. Match type and number of cables and conductors to control and communications requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.3 CONNECTIONS

- A. Ground equipment as indicated and as required by NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to perform the following field quality-control testing:
 - B. Testing: Perform the following field quality-control testing under the supervision of the manufacturer's factory-authorized service representative in addition to tests recommended by the manufacturer:
 - 1. Before energizing equipment, after transfer-switch products have been installed:
 - a. Measure insulation resistance phase-to phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Meet manufacturer's specified minimum resistance.
 - b. Check for electrical continuity of circuits and for short circuits.
 - c. Inspect for physical damage; proper installation and connection; and integrity of barriers, covers, and safety features.
 - d. Verify that manual transfer warnings are properly placed.
 - e. Perform manual transfer operation.
 - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.

- g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown sequence.
- C. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - 1. Assist in verifying grounding connections and locations and ratings of sensors.
 - 2. Assist in observing reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
- D. Coordinate tests with tests of generator plant and run them concurrently.
- E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 CLEANING

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain transfer switches and related equipment as specified below:
 - 1. Coordinate this training with that for generator equipment.
 - 2. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Project Closeout."
 - 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 5. Schedule training with Owner, through Architect, with at least seven days' advance notice.
 - 6. Provide a minimum of four hours of instruction.

END OF SECTION 26 36 00

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**SECTION 32 12 16
ASPHALT PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes provisions for hot-mixed asphalt paving over prepared base.
- B. Prepared base is specified in SECTION 02200 - EARTHWORK.
- C. Proof rolling of prepared base is included in this Section.
- D. Saw-cutting of edges of existing pavement is specified in site-clearing section.
- E. Header Board installation at edges of new asphalt pavement.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1.4 SITE CONDITIONS

- A. Weather Limitations: Apply prime and tack coats when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (1 deg C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
- B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 40 deg F (4 deg C) and when base is dry. Base course may be placed when air temperature is above 30 deg F (minus 1 deg C) and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.
- B. Asphalt Concrete: Type B, 1/2" maximum aggregate size as specified in Section 39 of the Caltrans Standard Specifications
- C. Prime Coat: SC-70 Liquid Asphalt as specified in Section 39 and 93 of the Caltrans Standard Specifications.
- D. Tack Coat: SS1 Asphaltic Emulsion as specified in Section 39 and 94 of the Caltrans Standard Specifications.
- E. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.
- F. Header Board: Pressure treated Douglas Fir for all lumber shown on the Drawings.

Redwood may be substituted for 1"x 6" material if pressure treated redwood is unavailable. Galvanized nails.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. General: Remove loose material from compacted base surface immediately before applying herbicide treatment or prime coat.
- B. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction.
- C. Notify Owner/Architect of unsatisfactory conditions. Do not begin paving work until deficient subgrade and base areas have been corrected and are ready to receive paving.
- D. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry base prior to application of prime coat.
- E. Prime Coat: Apply at rate of 0.20 to 0.50 gal. per sq. yd., over compacted subgrade. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.
- F. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at rate of 0.05 to 0.15 gal. per sq. yd. of surface.
- G. Allow to dry until at proper condition to receive paving.
- H. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.
- I. Install Header Board in the locations and as shown on the Drawings.

3.2 PLACING MIX

- A. General: Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225 deg F (107 deg C). Place areas inaccessible to equipment by hand. Place each course (2" maximum lift) to required grade, cross-section, and compacted thickness.
- B. Pavement Placing: Place in strips not less than 8 feet wide, unless otherwise acceptable to Architect. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- C. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.
- D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.

3.3 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas

- inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
 - D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.
 - E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained 95 percent laboratory density.
 - F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
 - G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
 - H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.4 FIELD QUALITY CONTROL

- A. General: Testing in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness will be done by Owner's testing laboratory. Repair or remove and replace unacceptable paving as directed by Architect.
- B. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:
 - 1. Base Course: Plus or minus 1/4 inch.
 - 2. Surface Course: Plus or minus 1/4 inch.
- C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
 - 1. Base Course Surface: 1/4 inch.
 - 2. Wearing Course Surface: 3/16 inch.
- D. Check surface areas at intervals as directed by Architect.

END OF SECTION 02511

SECTION 32 31 13
CHAINLINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, facilities, transportation and services to complete metal fences and gates and related work as shown on the Drawings and specified herein.
- B. Scope of Work:
The general extent of metal fences and gates is shown on the Drawings and includes, but is not limited to, the following:
 - 1. Furnishing and installing chain link fence, hardware, gates, gate center stops, gate center drop rod assembly, hinges, posts, and related appurtenances.
 - 2. Manual Gates and Hardware
 - 3. Finish painting
- C. Related sections:
 - 1. Submittals

1.02 REFERENCES AND REGULATORY REQUIREMENTS

- A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
- B. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- D. ASTM A569 – Steel, Carbon, Hot-Rolled Sheet and Strip, commercial quality.
- E. ASTM F567 - Practice for Installation of Chain-Link Fence.
- F. ASTM F668 – Specification for Poly (Vinyl Chloride) (PVC) – Coated Steel Chain Link Fence Fabric.
- G. ASTM F1083- Pipe, steel, hot-dipped zinc coated (galvanized), welded, for fence structures.
- H. SSPWC - Standard Specifications for Public Works Construction, 1997 Edition.
- I. CLFM - Chain Link Fence Manufacturer's Institute
- J. Chapter 19A, CBC.

1.04 SUBMITTALS

- A. Submit shop drawings including plan layout, grid, spacing of components, accessories, fittings, hardware, anchorages and schedule of components.
- B. Submit manufacturer's technical product data.
- C. Submit manufacturer's installation instructions.
- D. Submit three samples illustrating each fence fabric finish.
- E. Submit per section 01300

1.05 SEQUENCE AND SCHEDULING

- A. Coordinate construction timing with installation of mechanical equipment.

PART 2 – PRODUCTS

2.01 CHAIN LINK FENCE

A. Chain Link Fabric

1. Selvage: Fabric 72 inches high and over shall be knuckled at one selvage and twisted at the other; all mesh 60 inches high and under shall be knuckled at both selvages.
2. Steel Fabric: Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for fencing up to 12 feet high. Wire sizes includes zinc or aluminum coating.
2. Size: Two (2) inch mesh, 9-gauge (0.148 inch diameter) wide.
3. Galvanized Steel Finish: ASTM A 392, Class 2, with not less than 2.0 oz. Zinc per sq. ft. of uncoated wire surface on wire coated before weaving as determined from the average of two or more samples and not less than 1.8 oz. per sq. ft. of coated wire surface for any individual sample.

B. Fence Framing:

1. Strength requirements for posts and rails conforming to ASTM F 669.
2. Pipe shall be straight, true to section, material, and sizes specified, and shall conform to the following weights per foot:

NPS in Inches	Outside Diameter (OD) in inches	Type 1 Steel	Type II Steel
1	1.315	1.68	1.35
1 1/4	1.660	2.27	1.84
1 1/2	1.900	2.72	2.28
2	2.375	3.65	3.12
2 1/2	2.875	5.79	4.64
3	3.500	7.58	5.71
3 1/2	4.000	9.11	6.56
4	4.500	10.79	---
6	6.625	18.97	---
8	8.625	28.55	---

C. Steel Framework:

1. Posts, Rails, Braces, and Gate Frames:
 - a. Type I pipe: Hot-dipped galvanized steel pipe conforming to ASTM F 1083, plain ends, standard weight (Schedule 40) with not less than 1.8 oz. zinc per sq. ft. of surface area coated.
 - b. Type II pipe: Manufactured from steel conforming to ASTM A 569 or A 446, grade D, cold formed, electric welded with minimum yield strength of 50,000 psi and triple coated with minimum 0.9 oz. zinc per sq. ft. after welding, a chromate conversion coating and a clear polymer overcoat. Corrosion protection on inside surfaces shall protect metal

from corrosion when subjected to the salt spray test of ASTM B 117 for 300 hours with the end point of 5% Red Rust.

2. End, corner, and pull posts for the following fabric heights:
 - a. Up to 6 feet: 2.375 inch OD Type I or II steel pipe, 2 inch galvanized steel tube weighing 2.60 lbs. per lin. ft.
 - b. Over 6 feet: 2.875 inch OD Type I or II steel pipe, 2 ½ inch steel tube weighing 5.10 lbs. per lin. ft.
3. Line or intermediate posts for following fabric heights:
 - a. Up to 6 feet: 1.90 inch OD type I or II steel pipe, 1.875 inch.
 - b. Over 6 feet: 2.375 inch OD Type I or II steel pipe, 1.70 inch C section weighing 2.70 lbs. per lin. ft.
4. Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate width as follows:
 - a. Up to 6 feet: 2.875 inch OD type I or II steel pipe, 2 ½ inch galvanized steel tube weighing 5.0 lbs. per lin. ft.
 - b. Over 6 feet to 13 feet: 4.00 inch OD Type I or II steel pipe.
5. Special Fabricated Gate: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as detailed:
 - a. Top Rail: Manufacturer's longest length, with expansion-type couplings, approximately 6 inches long, for each joint. Provide means for attaching top rail securely to each gate corner, pull, and end post.
 - b. Galvanized Steel: ¼ inch NPS (1.66 inch OD) Type I or II steel pipe or 1.625 inch by 1.25 inch roll-formed C sections weighing 1.35 lb. per ft.
6. Fence Post Bolted Base: See detail 11/A1.1 for base plate connection.

D. Fittings and Accessories

1. Material: Comply with ASTM F626-96. Mill-finished aluminum or galvanized iron or steel, to suit manufacturer's standards.
 - a. Zinc Coating: Unless specified otherwise, galvanized steel fence fittings and accessories in accordance with ASTM A153/A153M-95, with zinc weights per Table 1.
 - b. Tension Wire: 0.177 inch diameter metallic-coated steel marcelled tension wire conforming to ASTM A 842 with finish to match fabric
 - c. Type II Zinc Coated in following class:
Class 2, with a minimum coating weight of 1.20 oz. Pper sq. ft. of uncoated wire surface
2. Tie Wires: 7 gauge galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating surface area in accordance with ASTM A 641, Class 3 or 9 gauge (0.106 inch diameter) aluminum wire alloy 1100-H14 or equal, to match fabric core material.
3. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive wire or top rail.
4. Tension or Stretcher Bands: Hot-dipped galvanized steel with minimum length 2 inches less than full height of fabric, minimum cross-section of 3/16 inch by 3/4 inch and minimum of 1.2 oz. zinc coating per sq. ft. of surface area. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric integrally woven into post.

5. Tension and Brace Bands: Minimum 3/4 inch wide hot-dipped galvanized steel with minimum 1.2 oz zinc coating per sq. ft. of surface area.
6. Fabric Ties: Minimum 7 gauge. Aluminum ties will not be allowed.

2.02 FABRICATION

A. Fabrication

1. Provide all new stock of standard sizes specified or detailed. Fabricate materials in shop to produce high grade metal work. Form and fabricate to meet required conditions.
2. Include bolts, screws and other fastenings necessary to secure the work.
3. Conform applicable work to latest edition of AISC Specifications and AWS D1.1 for Welding in Building Construction
4. Accurately make and tightly fit joints and intersections in true planes with adequate fastenings.
5. Coordinate the work with work of other sections. Provide all punchings and drillings indicated or required for the attachment of the work to other sections.
6. Welding: Weld joints, unless otherwise indicated or specified, using shielded electric arc method. Use coated welding rods, not fluxed or type recommended by manufacturer for use with parent metal.
7. Grinding: Grind welds to smooth, flush joints.

2.03 GATES

- A. Manually operated gate shall be fabricated to size and configuration indicated on drawings complete with gate hardware. When no hardware is detailed, provide 1" dia. minimum pole slide and 'C' latch and sleeve in ground. Hardware shall accommodate padlock.
- B. Gate Frames: 1-1/2 inch diameter steel pipe, welded corners, hot dip galvanized after fabrication.
- C. Sizes: As indicated on the drawings, minimum widths of gates shall not be less than 36".
- D. Hardware: Heavy-duty, galvanized ferrous metal industrial quality as manufactured by Master Nalco, Fontana, CA, or equal as approved in accordance with Division I for product options and substitutions.
 1. Hinges: Industrial malleable, three each leaf, ball and socket type, Series 15750.
 2. Gate Fork Latch: Malleable, Series 16600. Remove fork latch at gates requiring panic exit devices, see note 5 below.
 3. Latch Assembly: Malleable, Series 17200, drop rods at double gates.
 4. Locking: Provide padlock capability.
 5. Gate Hardware: Shall be mounted at 40" above finish floor
 - a. All attachments to gate shall be welded. No clamp-on or bolted fittings will be permitted.
- E. When a pair of gates is called for, contractor to include minimum 1" diameter cane bolt or pole slide with locking function to lock bolt in **UP** and **DOWN** position.

2.04 FINISH

- A. Following fabrication and prior to application of coatings, all metal shall be cleaned in a caustic solution to remove all grease, scale and rust.

- B. Chromate Conversion and Clear Acrylic Urethane Coating: Class 1A pipe, in accordance with Section 210-4, SSPWC. Color to be selected by Architect.
- C. Interior Surface Coating for Class 1A Pipe: In accordance with Section 210.3.2 SSPWC.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to installation of fencing, layout all equipment for approval by Architect.
- B. Preparation of Surfaces: It shall be the responsibility of this trade section to prepare all surfaces requiring paint finish. These surfaces shall be prepared to the standard of the trade and left without discrepancies, ready to receive paint, and in a condition acceptable for painting.

3.02 INSTALLATION OF CHAIN LINK FENCE

- A. Conform to layout shown on Drawings, except as modified by the Owner.
- B. Erect in strict conformance with approved Drawings, Shop Drawings, and manufacturer's recommendations.
- C. Install fence post base plates as shown in Drawings.
- D. Post shall be installed vertical and plumb.
- E. General: Install fence in compliance with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted. Apply fabric to outside of framework.
- F. Setting Posts: Space maximum 8 feet o.c., unless otherwise indicated. Match spacing of existing fencing when fencing is indicated to match existing.
- G. Top Rails: Run rail continuously through line posts caps, bending to radius for curved runs and at other posts termination into rail end attached to posts or post caps fabricated to receive rail. Provide expansion coupling as recommended by fencing manufacturer.
- H. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.
- I. Bottom Rails: Install bottom rails between posts 2" above finished grade unless otherwise noted on drawings. Provide all necessary trim and accessories as required for a complete installation.
- J. Fabric: Leave approximately 2 inches between finish grade and bottom selvages unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- K. Tension or Stretcher Bars: Thread through or clamp to fabric 4 inches o.c. and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.
- L. Tie Wires: Use U-shaped wire of proper length to secure fabric firmly to posts and rails with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing. Maximum spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.
- M. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- N. Gates: Install gates plumb, level, and secure for full opening without interference. Install groundset items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

1. Provide 1-7/8" O.D. bottom rail gate frame at fence locations.
- O. Vinyl Slats: Install vinyl inserts in accordance with manufacturer's recommendations, verify with Architect for horizontal, vertical, or diagonal installation. Color to be Green.

3.03 WARRANTY

- A. Provide two year warranty to insure materials against rusting or breakdown of finish. Provide adjustments as needed to assure continued smooth operation of gates.

3.04 TESTING

- A. At Owner's Representative's option, Contractor shall be required to cut any pipe column after installation to confirm requirements of this specification. If conformance is confirmed, replacement members shall be installed at Owner's cost. Components not meeting required standards shall be replaced.

END OF SECTION