



Fresno Unified
School District

**INFORMAL BID NO.
1140-35328 - EATON
ELEMENTARY SCHOOL
HVAC REPLACEMENT FOR
CLASSROOMS REBID**

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE (SITE WORK)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY:

A. Principle Work Items Are:

1. Concrete Work:
 - a. Rough concrete.
 - b. Finish concrete.
 - c. Specially finished concrete.
 - d. Bases for light poles.
 - e. School name sign with cast-in letters.
 - f. Grouting at folding panel partition sills.
2. Formwork.
3. Curing and protection.
4. Plastic membrane.
5. Off-site work:
 - a. Sidewalks, driveways, curbs and gutters.
6. Work installed but furnished by another Section:
 - a. Setting rough hardware and other embedded items.
 - b. Setting grates and frames for areaways.

B. Related Work Specified Elsewhere:

1. Furnishing rough hardware and other embedded items: Respective Sections.
2. EARTHWORK.
3. SITE DRAINAGE CONCRETE STRUCTURES.
4. CHAIN LINK FENCES AND GATES.
5. STEEL REINFORCEMENT.
6. BITUMINOUS DAMPPROOFING, at planters and retaining walls.
7. IDENTIFYING DEVICES.
8. Door sills: Respective Sections.
9. Rough concrete encasement for certain piping systems and concrete thrust blocks for piping systems: Various Sections of Division 22 & 23.
10. Rough concrete encasement for underground electrical conduits: Various Sections of Division 26.

1.3 SUBMITTALS:

A. Substitutions:

1. In accordance with Substitutions Procedure.
2. Only written approval of District will permit substitutions for materials specified. Refer to Section 00700, Article 30, Substitutions, for procedure.

B. Shop Drawings for Cast-in Letters: Full-size template layout of wording for school name sign.

C. Concrete Design Mix: By testing laboratory.

D. Test Reports: Source and Field Quality Control tests.

E. Certificates:

1. Weighmaster's Certificates: Per DSA requirements.
2. Certificate for Off-Site Work: Provide for all off-site work, per Paragraph

1.4 QUALITY ASSURANCE:

A. Design criteria; formwork:

1. Contractor shall be solely responsible for all formwork and Contractor shall:
 - a. Design, construct and maintain formwork to safely support all loads.
 - b. Obtain Governing Agency approval when such is required.

B. Testing Agency:

1. On-Site Work: District designated testing laboratory.
2. Off-Site Work: Governing Agency approved testing laboratory.

C. Requirements of Regulatory Agencies:

1. Codes: Conform to Titles 21 and 24 of the CCR and conform to CBC.
2. Off-site work:
 - a. Conform to Local Governing Agency requirements.
 - b. Obtain and pay for all permits, licenses and fees.
 - c. Arrange for all tests and inspections.

D. Tests and Inspection: General: Refer to Section 014000.

E. Allowable Tolerances for Concrete Surface Smoothness: 1/8" maximum permissible variation from a true plane measured from a 10' straight edge placed anywhere on the surface, non-cumulative.

F. Job Mock-Ups:

1. General:
 - a. Make samples on-site; revise as required; obtain District's approval, 10 days prior to casting finished work.
 - b. Finished work to match approved samples.

- c. Approved sample may be incorporated into the work.
 - 2. Specially Finished Concrete: Flatwork:
 - a. Sample size: 20 SF minimum.
 - b. Required for following finishes: Salt.
 - 3. Specially Finished Concrete; School Name Sign:
 - a. Sample size: 2 SF minimum wall area.
 - b. Required for following finishes: Sandblasted.
- G. Source Quality Control:
- 1. Testing laboratory shall provide continuous inspection at concrete batch plant for all structural concrete, defined as follows:
 - a. Footings, foundation walls, floor slabs-on-grade, exterior reinforced slabs.
 - b. Walls.
 - 2. Furnish Weighmaster's Certificates for all concrete.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. A. Storage; Concrete Materials:
- 1. Cement: Store in weather tight enclosures and protect against dampness, contamination and warehouse set.
 - 2. Aggregates
 - a. Stock pile to prevent excessive segregation or contamination with other materials or other sizes of aggregates.
 - b. Use only one supply source for each aggregate stock pile.
 - 3. Admixtures:
 - a. Store to prevent contamination, evaporation or damage.
 - b. Protect liquid admixtures from freezing or harmful temperature ranges.
 - c. Agitate emulsions prior to use.
- B. Delivery: Ready-Mixed Concrete: Conform to Title 24, CBC Chapter 19A.
- C. Formwork Materials:
- 1. On delivery to job-site, place materials in area protected from weather.
 - 2. Store materials above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.
 - 3. Handle materials to prevent damage.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements:
- 1. Allowable Concrete Temperatures:
 - a. Cold Weather: When depositing concrete in freezing or near-freezing weather, concrete mix temperature shall be between 50° and 90° F when cement is added. Maintain a concrete temperature of 50° F. minimum for 72 hours minimum after placing or until concrete has thoroughly hardened. When necessary, heat

concrete materials before mixing. Take necessary precautions to protect transit-mix concrete.

- b. Hot Weather: 90° F. maximum.

- B. Protection:
 - 1. Do not place concrete during rain, sleet, or snow unless protection is provided.
 - 2. After placement, protect from injury by elements, traffic, construction operations and other causes.

- C. Sequencing, Scheduling: Coordinate work with earthwork, trenching for foundations, underground utilities, plumbing, electrical, mechanical, Section furnishing imbedded items, steel reinforcement and related work of other Sections.

PART 2 - PRODUCTS

2.1 MATERIALS; GENERAL:

- A. Conform to Codes and additional requirements stated herein.

2.2 BASIC CONCRETE MATERIALS:

- A. Portland Cement:
 - 1. Type I or II; per CBC and ASTM C150.
 - 2. Use tested cement only. Use same cement brand for all exposed work.

- B. Water: Clean, fresh, free of injurious amounts of minerals, organic, substances, salts, acids or alkali.

- C. Aggregates:
 - 1. General: Per CBC.
 - 2. Hardrock Aggregates: Per CBC and ASTM C33.
 - a. Fine: Sand well graded from coarse to fine.
 - b. Coarse: Uniformly graded from 1/4" to maximum permissible size. Maximum size per Title 24, CBC Chapter 19A, but not to exceed 1" in any case.
 - 3. Lightweight concrete: Per ASTM Standard C330-80.

2.3 MATERIALS; CONCRETE ADDITIVES:

- A. Admixtures:
 - 1. General: Inclusion in concrete mix is at the Contractor's option and expense.
 - 2. Types:
 - a. Conform to Title 24, CBC Chapter 19A, which is based on ASTM C260, C494, C618. Admixtures shall increase workability and reduce water demand.
 - b. Acceptable Products:

- 1) Floor slabs-on-grade: Red Label or Anti-Hydro.

2.4 MATERIALS; CONCRETE SURFACE TREATMENTS:

A. Liquid Curing Compounds:

1. General: Conform to ASTM C309.
2. Acceptable Manufacturers: Hunt Process Co., Burke Co., Scofield Sonneborn.
3. Black, Permanent Type (for areas to receive resilient flooring or carpet):
 - a. Hunt Black, as a standard of quality.
4. Clear, Oxidizing Type (for areas to be exposed, interior or exterior):
 - a. Hunt Clear No. ARB as a standard of quality.

B. Floor Hardeners:

1. Color Hardeners; Dry shake:
 - a. Color: Natural gray.
 - b. Acceptable manufacturers and products:
 - 1) Scofield Co., Lithochrome, as a standard of quality.
 - 2) Master Builders, Colorcon.
 - 3) Sonneborn, Harcol.

C. Abrasive Grains:

1. Type: 60% minimum aluminum oxide abrasive, ceramically bonded to vitrification, neutral color, homogeneous, rustproof; crushed and graded from 1/32" to all passing 1/4" screen.
2. Acceptable Manufacturers and Products:
 - a. Norton Co., Alundum Fine DF, as a standard of quality.
 - b. Scofield Co., Lithochrome Abrasive Grains.

2.5 MATERIALS: CONCRETE JOINTS:

A. Metal Joint Form/Screed:

1. Type: 24 gauge galvanized formed steel, tongue and groove design, 7/8" diameter rebar knockouts at 6" on center; depth equal to slab depth. Complete system with form/screed, stakes, splice plates, clips and all accessories.
2. Acceptable manufacturers and products:
 - a. Burke, Keyed Kold, as a standard of quality.
 - b. Greenstreak, No. 500 Series, Joint Screed.
 - c. Heckmann, No. 95, Tongue and Groove Joint.
 - d. Jahn, Screed Key Joint.

B. Zip-top Control Joints:

1. Type: Extruded one-piece plastic T-shape, removable zip-off top.
2. Acceptable manufacturer, Zipcap.

C. Expansion Joints; Asphalt Impregnated Fiber:

1. Type: Cane fiber, p e-formed, waterproof asphalt impregnated; 1/2" thick x slab depth; per AASHO M213.
2. Acceptable Manufacturers and Products:
 - a. Burke Co., Fiber Expansion Joint.
 - b. Sonneborn, Sonoflex.

2.6 MATERIALS; SPECIALLY FINISHED FLATWORK:

- A. Rock Salt: Commercial coarse granular-type, (similar to that used in water softening systems) sized from 1/4" to 3/8", with 65% 3/8" in size.

2.7 MATERIALS; WOOD FORMWORK:

- A. Grade Marks and Rules For Lumber and Plywood: Per Section ROUGH CARPENTRY.
- B. Framing Lumber; General: Douglas Fir; Standard Grade Light Framing or better.
- C. Boards for Unexposed Concrete and Basic Forms: Douglas Fir, S4S; Standard Grade or better.
- D. Plywood:
 1. For unexposed concrete and basic forms: Douglas Fir; Exterior Grade C-C or better.
 2. For exposed concrete: Douglas Fir Plyform, Exterior Class 1; B-B wood face or high density overlay sheet (HDO).
- E. Form Ties; Typical:
 1. Type: Snap-ties, carbon steel, 1/4" maximum diameter, 1" minimum break back, 5,000 lb. minimum strength; adjustable or accurately sized.
 2. Acceptable manufacturers and products:
 - a. Burke, Penta-Tie, as a standard of quality.
 - b. Concrete Tie, Contac.
- F. Form Coatings and Release Agents--Types:
 1. Per manufacturer's recommendations, suitable for type of form materials and finished concrete surface.
 2. Materials shall not stain or change color of exposed concrete.
 3. Materials shall be compatible with finishes to concrete.
- G. Chamfers and Control Joints:
 1. General: Wood or plastic, saw kerf backs, 15 taper sides, width or least equal to depth, configurations as required.
 2. Chamfers: 3/4" minimum width.

2.8 MATERIALS; ACCESSORIES AND MISCELLANEOUS:

- A. Leveling Filler For Floor Slabs:

1. Type: Liquid latex compound and filler powder.
 2. Acceptable manufacturers and products:
 - a. Flintkote, Latex Underlayment Binder and Powder.
 - b. Dowman Products, Fixallatex latex underlayment.
 - c. Webtex No. 660 Latex Underlayment.
- B. Nailing Blocks and Other Embedded Wood: Pressure-treated Douglas Fir, per Section ROUGH CARPENTRY.
- C. Sand for Sandblasting: Hard, sharp, quartz sand.
- D. Non-Shrink Grout Por-Rok by Hallemite Co; Masterflow No. 713 Grout by
- E. Master Builders; Lithochrome, TRU Grade, by Scofield.
- F. Cast-in Letters for School Name Sign: Wood block style letters similar to West-On Letters, Inc. products.
- 2.9 MIXES; CONCRETE:
- A. Mix Proportioning:
1. General:
 - a. Designed Mix, per Title 24, CBC Chapter 19A , and ACI 318; for all concrete.
 - b. Mix design by designated Testing Laboratory.
 - c. Design shall include all admixtures and/or additives, if any. Use as approved by DSA.
 - d. Do not add salt, chemicals, or other materials to mix to prevent freezing.
 2. Strengths, Proportions and Criteria:
 - a. 2,500 psi Concrete: Typical for all locations; except where higher strengths are indicated.
 - 1) Strength: 2,500 psi and 28 days; 1,500 psi at 7 days.
 - 2) Cement content, minimum 5-1/4 sacks (94#) cy.
 - 3) Slump maximum: 4".
- B. Mixing:
1. General: Per Title 24, CBC Chapter 19A and ASTM C94.
 2. Batch Mixed: Use ASTM C94 batch mixer; or capacity to handle one or more full sack batches. No split-sack batches.
 3. Transit Mixed: Per ACI 318.
 4. Mix concrete only in quantities necessary for immediate use.
 5. Do not re-temper concrete.
 6. Discharge all wash water from mixer before reloading.
 7. Include additives and admixtures.

2.10 MIXES; DRYPACK:

- A. Mix Proportions: One part cement, 1 1/2 parts sand (fine aggregate).
- B. Mixing: With sufficient water to make a stiff mixture, which can be molded by hand into a sphere.

2.11 MIXES; GROUT MIX FOR SACKED FINISH:

- A. Mix Proportions: One part cement, 1 1/2 parts fine sifted sand.
- B. Mixing: With sufficient water, to the consistency of thick paint.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine excavations for foundations, footings, structures and examine earthwork operations and subgrade for defects that will adversely affect the execution and quality of work.
- B. Do not start work until unsatisfactory conditions are corrected.

3.2 PREPARATION:

- A. Layout: Accurately lay out work to properly position all elements to lines and levels.
- B. Joining to Previous Pours or Existing Work: Sandblast, roughen and clean existing joining concrete and rebar surfaces to provide a proper bond to new work.

3.3 WOOD FORMWORK:

- A. Scope:
 - 1. General: All concrete shall be cast-in forms.
 - 2. Footings: When specifically approved by District/Engineer and DSA, earth banks may be used as forms in lieu of wood forms.
- B. Form Face Types:
 - 1. Unexposed Concrete: Plywood or horizontal boards.
 - 2. Exposed Concrete:
 - a. General: All new materials, or materials reconditioned to like new.
 - b. Typical Work: Plywood panels, 4' x 8' typical size. Layout symmetrically, long diameter vertical; panels stacked; all joints aligned, level, plumb, and tight.

- C. General Construction:
 - 1. Forms shall be substantial, unyielding, true to line and level; sufficiently tight to prevent leakage of mortar; adequately tied and braced; and conform exactly to dimensions of finish concrete.
 - 2. Forms shall provide adequate work clearances, temporary access openings necessary for concrete placement, provisions for attachment to previous work; and provide for stripping without injury to concrete work.
 - 3. Cleanouts: Provide continuous cleanouts on one side at bottom of vertical work (such as walls), and other openings as necessary to facilitate cleaning and inspection of the work.

- D. Fabrication:
 - 1. Nail board and/or plywood form faces securely to studs. Space studs to adequately support form faces and prevent bulging. Provide stud or solid backing at all joints.
 - 2. Install chamfer strips at all exposed corners and edges.
 - 3. Securely fasten chamfers, control joints and other detail work.

- E. Erection:
 - 1. General: Erect formwork plumb and level; double wales; adequately brace, shore and support; set so finished concrete surfaces will drain.
 - 2. Ties and Spreaders:
 - a. General: Position to securely anchor forms; maintain accurate wall dimensions, true surfaces and prevent bulging.
 - b. Exposed Concrete: Position in similar symmetrical patterns.
 - 3. Footings and Foundation Walls: Form both sides; secure to stakes.
 - 4. Walls: Form both sides; set so tops of exposed work will be a straight, level line.

- F. Form Coatings and Release Agents: Apply, per manufacturer's recommendations, to evenly coat all contact surfaces.

3.4 INSTALLATION; EMBEDDED ITEMS:

- A. General:
 - 1. Install per Title 24, CBC Chapter 19A.
 - 2. Place accurately; anchor securely to prevent displacement.
 - 3. No wood to be permanently embedded in concrete, except where indicated.
 - 4. Coordinate, notify, provide access for other Sections to set their required work.

3.5 INSTALLATION; GRATES AND FRAMES FOR AREAWAYS:

- A. Install accurately, level, at proper elevations, securely anchored, and with all fastenings in place.

3.6 INSTALLATION; SCREEDS FOR SLABS, WALKS AND FLAT WORK:

- A. General:
 - 1. Set and securely support screeds accurately to lines, levels and grades required for finished work.
 - 2. Where membranes occur, supports shall not puncture membranes.
 - 3. Spacing: 8' 0" on center typically; closer intervals where construction conditions require.

- B. Permanent Metal Joint Form/Screeds:
 - 1. Scope: Install in all exterior slabs, walks, paving and flatwork.
 - 2. Spacing/Location: 20'-0" on center maximum each way; all points where concrete changes direction; and where indicated.
 - 3. Installation: Burke Keyed Kold system, as a standard of quality.
 - a. Stakes: Space 2'-0" on center typical, and 6" maximum from ends of runs.
 - b. Screeds: Hang screeds on stakes, crimp top leg into hole in stake, clip bottom leg to stake, butt joints and install splice plates.
 - c. Coating: Oil screeds prior to concrete placement.
 - d. When concrete pour is against one side only, bend knock-out tabs into pour at 45° approximate.

3.7 INSTALLATION; PLASTIC MEMBRANE:

- A. Scope:
 - 1. Install under all interior floor slabs on-grade.

- B. Installation:
 - 1. General: Place over prepared 2" sand over compacted earth, cover with 2" sand, prior to steel reinforcement placement. Use as large sheets as practicable. Cut and fit neatly around all penetrations.
 - 2. Joints: Lap 6" typical; lap floor sheets 2' 0" minimum over footing sheets.
 - 3. Taping: Spot tape joints to hold sheets in place. Tape seal all punctures and around all penetrations and all lap joints.

3.8 PREPARATION; CONSTRUCTION JOINTS:

- A. General:
 - 1. Comply with Title 24, CBC Chapter 19A.
 - 2. Locate joints where they will least impair strength of structures.
 - 3. For joints at locations other than those indicated, obtain District/Engineer approval.

- B. Preparation:
 - 1. Clean and roughen entire joint face to remove entire surface and expose clean aggregate solidly embedded in mortar matrix by one of the following methods.
 - a. Sandblast or chip, not earlier than five days after initial pour.
 - b. Hose wash clean between two and four hours after concrete is placed. Remove all wash water, laitance and debris.
 - 2. Vertical Joints: Wet and flush with neat cement grout, just prior to concrete placement.

3. Horizontal Joints: Wet and deposit 2" to 6" layer of specified modified concrete mix, prior to placing regular mix.

3.9 PREPARATION; SLABS-ON-GRADE:

- A. Tamp sand sub-base to a firm unyielding surface.

3.10 CONCRETE PLACEMENT:

- A. General: Comply with Title 24, CBC Chapter 19A.

- B. Preparation and Inspection Prior to Concrete Placement:

1. Preparation--do not place concrete until:
 - a. Footing excavations are cleaned and dry.
 - b. Steel reinforcement is correctly positioned, securely anchored and cleaned.
 - c. Forms are cleaned, coated, and ties are tightened.
 - d. Embedded items are positioned and anchored.
 - e. Construction joints are cleaned and prepared.
 - f. Subgrade is prepared and moistened.
 - g. All preparations for a pour are completed.
 - h. Work has been inspected.
2. Inspection: All formwork, steel reinforcement, footing excavations and preparation work (as stated in Paragraph No. 1.2. A) to be inspected and approved by District/Engineer, prior to pouring any concrete.

- C. Placement:

1. Convey concrete from mixer to final position by method, which will prevent separation or loss of material and cause minimum handling.
2. Deposit concrete in continuous operation will panel or section is completed.
3. Regulate rate of placement so concrete remains plastic and flows into position.
4. Keep tops of vertical lifts approximate level during placement.
5. Maximum permissible free-fall for concrete is 3'. Use elephant trunks or other approved means necessary to meet this limitation.
6. Maximum permissible thickness of concrete layers is 2'.
7. Where reinforcement is congested or consolidation is difficult, specified modified concrete mix may be used in a 2" to 6" layer.
8. Special conveyance and placement methods may be used with prior approval of District/Engineer and DSA.
9. Do not use partially hardened or contaminated concrete; do not retemper concrete; or do not use concrete, which has been remixed after initial set.

- D. Consolidation:

1. Use mechanical vibrating equipment. Supplement with hand rodding, spading and tamping.
2. Vertically insert and remove hand-held vibrators.

3. Work concrete thoroughly around reinforcement, embedded items and into all parts of forms.
 4. Consolidate to a dense, uniform mass without voids, rock pockets, or entrapped air. Consolidate each layer.
- E. Slabs, Walks and Flatworm:
1. Lift reinforcement as placement progresses to proper position in slab.
 2. Tamp and screed to required lines and levels.
 3. Depress coarse aggregate with grille-blade tamper.
- 3.11 FINISHING FLATWORK; TYPICAL:
- A. Scope: Finish all flatworm as specified herein.
- B. Interior Slabs:
1. General:
 - a. Monolithically finish all slabs.
 - b. Do not dust with dry cement to remove water.
 2. Floating:
 - a. Power float upon disappearance of water shown.
 - b. Hand float areas inaccessible to power float.
 3. Trowel Finishing:
 - a. Areas depressed for ceramic and quarry tile: Further finishing is not required.
 - b. Areas to receive carpet and resilient floor coverings: Power trowel to a dense, smooth, even surface, until no more excess water may be brought to surface.
 - c. Exposed concrete areas: Gray color hardened.
 4. Just prior to floating, evenly apply 20 lbs. hardener per 100 SF.
 5. After floating, spot touch-up uneven areas; then evenly apply ten lbs. hardener per 100 SF.
 6. First Troweling: Power trowel per Paragraph B above.
 7. Hand steel trowel (causing trowel to ring) to a smooth, slick, burnished surface, free of defects and blemishes.
- C. Exterior Flatworm (slabs, walks, paving and similar work):
1. General:
 - a. In indicated areas, finish concrete as specified herein, in lieu of typical finishes.
 - b. All work to match approved samples.
 - c. The Contractor is to limit pour areas and provide sufficient ratio of finishers to produce specified finishes.
 2. Sweated Finish; Typical:
 - a. Two steel troweling IS, while concrete is still green.
 - b. Non-slip sweated finish with regular light trowel marks in an approximately 2' circular arc pattern.
 3. Salt Finish; where Indicated:
 - a. Preparation: Screed and float. Steel trowel smooth and even in circular arc pattern, free of blemishes and ridges.

- b. Salt Application:
 - 1) While concrete is still plastic evenly and uniformly seed surface at 10 ls. minimum per 100 SF; 3" maximum between pockmarks any where on surface.
 - 2) Press, roll or trowel salt grains to embed them flush with concrete surface; do not shatter salt grains.
 - 3) After concrete sets, completely dissolve and wash salt away from planting areas.
 - 4. Marking:
 - a. Type; Typical: V-groove radius tool.
 - b. Patterns: Follow indicated patterns; where not indicated, mark as follows:
 - 1) Walks: Into squares, equal to walk width.
 - 2) All areas 8' or wider: Into approximate squares, 8' maximum diameter.
 - D. Tooling: Radius tool all exposed edges, edges adjacent to all permanent wood headers and edges at each side of all metal joint screeds..
 - 1. Abrasive Surface Treatment:
 - a. Scope: Apply to all exterior and interior exposed concrete steps and ramps and where indicated:
 - b. Ramp defined as surface sloping ½" or steeper.
 - 2. Application: Apply evenly at 25 ls. per 100 SF just prior to final troweling Tamp and trowel to securely embed, but not cover abrasive.
- 3.12 FLATWORK CONTROL JOINTS:
- A. General: Conform to Title 24, CBC Chapter 19A.
 - B. Interior Slabs-on-Grade:
 - 1. General: Create construction joints to divide slabs into 400 SF maximum approximate rectangular shapes, by any of the following methods.
 - a. Alternate pours, checkerboard pattern.
 - b. Saw cutting within 12 hours from time of pour.
 - c. Install Zip-Top control joints concurrently with tamping and floating work. Using sawing motion, push straight-edge into concrete to form groove. Insert Zip-Top control joint into groove, using sawing motion, until joint top is flush with concrete surface. When concrete sets sufficiently, pull-off removable top flange.
 - 2. Location: Locate joints typically to occur under partitions, avoid exposed concrete floor areas; align with structural features, points where slab changes configuration or direction and points where stresses localize.
 - C. Exterior Flatworm (Walks, Paving and Similar Work); General: Construction joints formed by permanent Metal Joint Form/Screeds per Paragraph 3.06 B.
- 3.13 FORMWORK REMOVAL:

- A. General: Do not remove or disturb forms, shoring or bracing until concrete has hardened sufficiently to permit safe removal, support all imposed loads including its own weight, nor in any case until the following minimum times have elapsed:
 - 1. Foundation Walls: Three days.
 - 2. Slabs-On-Grade: Three days.
 - 3. Walls: Three days.
 - B. Ties: Remove or snap-off ties, spreaders, tie rods, and other devices so no metal is left within 1" of concrete face.
 - C. Exposed Concrete Work: Carefully remove formwork and detail strips so surfaces, corners, edges, details, and all features will be true, level, sharp, unbroken, unmarred or damaged in any way.
- 3.14 PROTECTION AND CURING OF CONCRETE:

- A. Protection: Protect all work from injury and defacement of any nature during construction operations.
- B. Curing:
 - 1. General:
 - a. Keep concrete surfaces wet until curing medium is applied.
 - b. Cure drypack same as concrete.
 - 2. Walls, Mass and Reinforced Concrete:
 - a. Scope: Maintain in a thoroughly wet condition all forms containing concrete, top of concrete between forms, all exposed concrete surfaces after removal of forms.
 - b. Time Period: Wet continuously each day for 10 consecutive days, including Saturdays, Sundays and holidays.
 - 3. Flatwork:
 - a. Scope: Apply specified liquid curing compounds to all interior floor slabs, and all exterior flatwork (slabs, walks, paving, and similar work).
 - b. Application: Apply uniform, continuous, tightly adhered film, free from pinholes or defects at rate of 1 gallon per 250 SF.

3.15 FINISHING WALLS AND VERTICAL CONCRETE SURFACES; TYPICAL:

- A. Scope: Finish all walls and vertical concrete surfaces as specified herein, except for school name sign.
- B. Exposed Concrete at Tops of Forms:
 - 1. Strike concrete smooth and level.
 - 2. Float and/or trowel to texture comparable to formed surfaces.
- C. Preparation, Formed Surfaces:
 - 1. Remove fins and irregularities while concrete is green.

2. Tie Holes: Fill full and flush with compacted drypack.
3. Surface Defects:
 - a. Cut out blemished and defective areas as directed by the District.
 - b. Patch flush with drypack, typically, or as directed by the District.
- D. Cleaning:
 1. Exposed Surfaces:
 - a. Remove form coatings, bond breakers and other surface coatings.
 - b. Scrub form surfaces with solution of 1 1/2 lbs. caustic soda per 1 gallon water.
 - c. Scrub smooth wood or waste mold areas with 20% muriatic or hydrochloric acid solution.
 - d. Wash surfaces clean with clear water, immediately after scrubbing.
 - e. If above methods fail to remove all substances, lightly sandblast surfaces clean as directed by the District.
 2. Surfaces with Finish Materials Applied Directly to Concrete: Clean as stated for Exposed Surfaces, except where uncleaned surface will not affect application, bond, performance or appearance of finish materials.
- E. Sacked Finish for All Exposed Concrete:
 1. General: Schedule work to complete entire panel, element or area in one continuous operation.
 2. Application:
 - a. Wet surface to control suction of water from grout.
 - b. Apply grout mix; uniformly spread and scour to fill depressions.
 - c. While still plastic, sponge rubber float finish surface and remove excess grout.
 3. Sacking: Allow surface to dry, but not completely harden; then rub vigorously with clean dry burlap to remove loose excess material. Finished surface to have a smooth slick burnished finish (similar to a steel trowel finish), which is free of defects and blemishes.

3.16 PREPARATION OF HORIZONTAL CONCRETE SURFACES TO RECEIVE MASONRY WALLS:

- A. Prepare and roughen as specified for horizontal concrete construction joints in paragraph 3.08, B, 1.

3.17 SCHOOL NAME SIGN; CAST-IN LETTERS:

- A. Accurately set letters in place; space to match approved Shop Drawings.
- B. Coat with bond breaker. After concrete hardens, carefully remove wood letters to leave sharp, clean recesses in the concrete.
- C. Sandblast Finish:
 1. General:
 - a. Scope: Heavily and uniformly sandblast to expose coarse aggregate.
 - b. All work to match approved samples.

- c. Complete entire side in one continuous operation.
2. Preparation: Per Paragraphs 3.15, B and C.
3. Sandblasting:
 - a. Wet or dry processes, as permitted by Local Governing Ordinances.
 - b. Control dust from drifting to adjacent areas.
 - c. Where wet process is used, build dams and otherwise control and direct flow of run-off water.
4. Cleaning:
 - a. Wash down all blasted surfaces with clear water to remove dust, sand and leave them clean.
 - b. Remove all blasting sand and debris.

3.18 FIELD QUALITY CONTROL:

- A. General: Refer to Section 01400, Testing and Inspection.
- B. Inspections:
 1. Steel reinforcement.
 2. Structural concrete.
- C. Tests:
 1. Concrete slump.
 2. Making concrete compression test cylinders.
 3. Core tests of defective work.

3.19 ADJUSTMENT AND CLEANING:

- A. Correction of Defective Work:
 1. General: Work not conforming to Contract requirements shall be removed and replaced; except where patching or other remedial work is specifically permitted by the District. The Contractor shall bear all costs of correction of defective work.
 - a. Surface patching materials and methods shall be as approved by the Architect.
 - b. Structural concrete replacement, strengthening, and/or repair methods and materials shall be as approved by District/Engineer and the Office of the State Architect.
 2. Filling and Leveling Slab Surfaces to Receive Resilient Flooring or Carpet:
 - a. High Spots: Remove, hone or power grind to required levels.
 - b. Low Spots: Fill to required levels with specified Leveling Filler, mixed and applied manufacturer's recommendations.
- B. Cleaning: Clean exposed surfaces just prior to acceptance.

END OF SECTION

SECTION 220000
GENERAL MECHANICAL AND PLUMBING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. This division requires the furnishing and installation of items specified or indicated on the drawing or reasonably inferred there from, including every article, device or accessory necessary to facilitate each system's functioning as a complete and lawful system.
- B. General Requirements, Division 01 of the Specifications, pertains to and is hereby made a part of Divisions 22 and 23. Contractor is to review the conditions and requirements of Division 1, including Sections on submittals and job site conditions and procedures.
- C. Electrical power and control wiring 50 volts and greater, motor starters, and disconnects are included in FACILITY SERVICES SUBGROUP, unless otherwise noted.

1.2 SCOPE OF WORK:

- A. This work shall consist of, but not be limited to, the following: Furnish and install plumbing fixtures and piping as shown for a complete and functioning system; and furnish and install chiller, boilers, unit ventilators, fans, controls, ductwork, grilles, flex duct and dampers as shown for a complete and functioning system. Prior to fabrication of ductwork, contractor shall verify clearances to determine if structural or other trades have infringed on the space allotted for mechanical equipment. If interferences occur, notify the General Contractor, District and the Architect or Mechanical Engineer.

1.3 FEES AND PERMITS:

- A. The contractor shall secure all permits, licenses, and inspections required for this work as outlined in Division 01.

1.4 CODES AND REGULATIONS:

- A. All work and materials shall be in accordance with the following codes as adopted and amended by the authority having jurisdiction. Nothing in these drawings or specifications is to be construed to permit work not conforming to these codes. Should the drawings or specifications call for material or methods of construction of a higher quality or standard than required by these codes, the specifications shall govern.
 - 1. California Code of Regulations:
 - a. Title 8, Industrial Relations.
 - b. Title 19, Public Safety.
 - c. Title 20, Building Standards.

- d. Title 24, Building Standards.
2. California Building Code.
3. California Mechanical Code.
4. California Plumbing Code.
5. Standards and regulations of other agencies or organizations, as listed in this specification relating to products or procedures. For example, American National Standards Institute, American Society for Testing and Materials, American Society of Mechanical Engineers, etc.

1.5 GUARANTEE:

- A. Guarantee shall be in accordance with the General Conditions. These specifications may extend the period of guarantee for certain items. Where such extensions are called for, or where items are normally provided with guarantee periods in excess of that called for in the General Conditions, the certificate of guarantee shall be furnished to District per Specification Section – GUARANTEES.

1.6 DRAWINGS:

- A. Layout of equipment and systems is generally diagrammatic, unless specifically dimensioned. Drawings shall be checked for interferences with structural or other conditions before installing work. Interferences shall be called to the attention of the District.

1.7 DEFINITIONS:

- A. Piping: The term piping shall mean all pipe, fittings, valves, insulation and accessories as required for a complete piping system.
- B. Agencies and Organizations:
 1. AABC - Associated Air Balance Council
 2. AAR - Association of American Railroads
 3. AGA - American Gas Association
 4. AMCA - American Moving and Conditioning Association
 5. ANSI - American National Standards Institute
 6. ARI - Air Conditioning and Refrigeration Institute
 7. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
 8. ASME - American Society of Mechanical Engineers
 9. ASTM - American Society for Testing and Materials
 10. AWWA - American Water Works Association
 11. AAPMO - International Association of Plumbing and Mechanical Officials
 12. NEMA - National Electrical Manufacturers' Association
 13. NEBB - National Environmental Balancing Bureau
 14. NFPA - National Fire Protection Association
 15. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
 16. UL - Underwriters' Laboratories

PART 2 - PRODUCTS:

2.1 QUALITY STANDARDS OF MATERIALS:

- A. The listing of product manufacturers in the various sections of the specifications and drawings is intended to establish a standard of quality only. It is not the intent of the Engineer to discriminate against any material or product that is equivalent, in the opinion of the Engineer, to the standards as described in the specifications and drawings, nor is it intended to preclude open competitive bidding.
- B. Products by other manufacturers will be accepted as outlined in Division 1, Specification Section - SUBSTITUTIONS. No products will be reviewed less than 10 days prior to bid date.
- C. The contractor shall submit to the District copies of complete lists of materials proposed for use, giving manufacturer's name and catalog numbers. Complete shop drawings shall follow for all equipment and fixtures. Shop drawings shall include dimensions, capacities, performance curves and other characteristics as listed in product specifications. Material or equipment shall not be ordered until a written reply is received from the District indicating review and approval of the submittals.

PART 3 - EXECUTION

3.1 TESTING AND START-UP:

- A. ~~Refer to Division 01, and individual sections, for requirements for clean-up, testing, balancing and start-up.~~
- B. ~~The HVAC system shall be balanced by a contractor licensed by a nationally recognized air balance certification agency to the to the satisfaction of the District's representative per Specification Section - TESTING, ADJUSTING AND BALANCING.~~
- C. The piping systems shall be tested in accordance with the California Plumbing Code. Domestic hot and cold water piping shall be tested at 100 psig air pressure for a period of 2 hours. Gas piping shall be tested at 60 PSIG air pressure for a period of 1 hour. Sewer piping shall be tested with a water column to the height of the highest vent line. There shall be no detectable drop in pressure during the test, except that associated with temperature change. The gauge used shall have a least count of 1 PSIG and a range not greater than 150% of the testing pressure.
- D. Maintenance and operations manuals shall be provided at the conclusion to the project. They are to be loose-leaf vinyl covered binders with the project name displayed on the spine of the book in 1/2" high letters. Indexed tabs shall identify the individual sections. The manuals shall include installation, repair manuals provided by the equipment manufacturers, parts lists, listing of local supplier which carries replacement parts, wiring and control diagrams, air balance report, and other pertinent data. Copies shall be delivered to the Engineer for review prior to submission to the District as outlined in Division 1.
- E. Verbal: The Contractor shall also verbally instruct the District's maintenance staff in the operation and maintenance of all equipment and systems.

SPECIFICATIONS

3.2 WORKMANSHIP:

- A. All work done under this Division shall be the highest quality for the trade. Ductwork and piping shall be parallel to building lines. Exposed work shall be properly finished to reflect pride in workmanship.

3.3 SITE VISITATION:

- A. Prior to bidding this project, the contractor shall visit the site and become familiar with the site conditions. The contractor shall verify the work to be performed. Failure to visit the site will not be accepted as an excuse for extra compensation for visible obstacles.

END OF SECTION

SECTION 220750 PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Piping insulation.
- B. Jackets and accessories.
- C. No asbestos allowed.

1.2 REFERENCES:

- A. Insulation shall comply with California Title 24, Energy Conservation Standards.

1.3 QUALITY ASSURANCE:

- A. Applicator Company specializing in piping insulation application with three years minimum experience.
- B. Materials: Flame spread/fuel contributed/smoke developed rating of 25/50/50 in accordance with ASTM E84, NAPA 255, UL 723.

1.4 SUBMITTALS:

- A. Submit product data under provisions of Specification Section - SUBMITTALS.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions under provisions of Specification Section - SUBMITTAL.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Knauf.
- B. Certainteed.
- C. Armstrong.

- D. Substitutions: Under provisions of Fresno Unified School District Division 01.

2.2 FIBERGLASS INSULATION:

- A. Glass fiber insulation; ANSI/ASTM C 47; 'k' value of 0.24 at 75 degrees F; noncombustible. Preformed with all service jacket.

2.3 FOAM INSULATION:

- A. Cellular foam; flexible, plastic; 'k' value of 0.28 at 75 degrees F. Armaflex FR or equivalent For 3/4" and smaller pipes or refrigerant piping.

2.4 JACKETS:

A. Interior Applications:

1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
2. PVC Jackets: One-piece, premolded type. Comply with Paragraph 1.03, B.

B. Exterior Applications:

1. Aluminum Jackets: ASTM B209; 0.020 inch; smooth finish.
2. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; smooth finish.
3. Cellular foam insulation to have manufacturer's approved coating for UV protection.

2.5 ACCESSORIES:

- A. Insulation Bands: 3/4-inch wide; 0.015-inch thick stainless steel, or 0.007-inch thick aluminum depending on jacket.
- B. Metal Jacket Bands: 3/8-inch wide; 0.015-inch thick aluminum. 0.010-inch thick stainless steel.
- C. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
- D. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Install materials after piping has been tested and approved.

3.2 INSTALLATION:

- A. Install materials in accordance with manufacturer's instructions.

- B. Continue insulation with vapor barrier through penetrations.
- C. In exposed piping, locate insulation and cover seams in least visible locations.
- D. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- E. On insulated piping without vapor barrier and piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
- F. Provide an insert, not less than six inches long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping two inches diameter or larger, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Kin-Line 463 or 466 insulation rings.
- G. Neatly finish insulation at supports, protrusions, and interruptions.
- H. Jackets:
 - 1. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. All service or PVC jackets may be used.
 - 2. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature shall have vapor barrier jackets. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. All service or PVC jackets may be used.
 - 3. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Provide PVC or metal jackets unless metal jacket is specifically required.
 - 4. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum or stainless steel jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Caulk with silicone (clear or silver) at all joints.
 - 5. Buried Piping: Provide factory fabricated assembly with PVC pipe jacket and foam insulation (equivalent to PermaPipe).

3.3 SCHEDULE:

- A. Comply with California Title 24 Energy Conservation Standards as minimum.
- B. Provide 1" minimum on domestic hot water. Insulate cold water line to water heater per Code.
- C. Provide 1 1/2" minimum for chilled or heating hot water mains and 1" or branches.
- D. Provide 1/2" on all cold water exposed to exterior.

END OF SECTION

SECTION 260000
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This Section provides the Basic Electrical and Material Requirements, which supplement the General Requirements of Division 1 and apply to all Facility Services.
- B. Related Work:
 - 1. Excavating, Backfilling and Compacting for Utilities.
 - 2. Steel Reinforcement.
 - 3. Cast-in-Place Concrete.

1.02 BASIC ELECTRICAL REQUIREMENTS:

- A. Drawings and Specifications coordination:
 - 1. For purposes of clearness and legibility, the electrical drawings are essentially diagrammatic. The size and location of equipment is shown to scale whenever possible. The Contractor shall verify all conditions, data and information as indicated on the drawings and in Specifications Sections where electrical work is required prior to installation.
 - 2. The Electrical Drawings show size and points of termination of the conduits, the number and size of wires, and suggest the proper route for the conduit. It shall be the responsibility of the Contractor to install the conduits with minimum number of bends to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and meet all applicable Code requirements. The routing of conduits may be changed, if approved by the District Electrical Inspector.
If the length of a conduit run is increased more than 10% of the length shown on the drawings, the Contractor shall consider worst case voltage drop and adjust wire and conduit size accordingly in compliance with Code. If the length of a conduit run is decreased more than 10% of the length shown on the drawings, the Contractor shall offer a credit to the District for the length and size of the conduit and wire deleted.
 - 3. It is intended that outlets be located symmetrical with Architectural elements notwithstanding the fact that locations shown on the drawings may be distorted for clarity.
 - 4. The Architectural and Structural Drawings take precedence over the electrical drawings in the representation of the general construction work. The drawings of the various trades take precedence in the representation of the work of those trades. The Contractor shall refer to all drawings to coordinate the electrical work with the work of other trades to eliminate all conflicts.
- B. Terminology:
 - 1. The term "signal system" shall apply to the clock, bell, fire alarm, annunciator, sound, public address, buzzer, public telephone, television, inter-communication, and security systems.
 - 2. The term "low voltage" shall apply to systems operating at 600 volts and under.

3. The term "provide" used on the drawings and elsewhere in the Specifications shall be considered to mean furnish and install.
 4. The term "U.L." means Underwriters Laboratories, Inc.
- C. Ordinances and Regulations:
1. Electrical work shall meet requirements of local authorities having jurisdiction, including municipal ordinances, City and/or County Building Codes, the California Administrative Code Title 24, the Safety Orders of the State Division of Industrial Safety, and the Fire and Panic Safety Standards of the State Fire Marshal. Material and labor shall conform to the Regulations of the National Board of Fire Underwriters for Electrical Wiring and Apparatus. All new material shall be U.L listed. The latest Electrical Ordinance of the local jurisdiction, including amendments thereto, effective on the date of opening bids for the work, is hereby made a part of this Specification, and shall apply to all work, except for those portions which conflict with the requirements of the local authorities.
 2. Meet the requirements of the latest National Electrical Code adopted by the local jurisdiction.
 3. Electrical work shall comply with the American National Standards Institute (ANSI), which includes the National Electrical Installation Standards (NEIS).
- D. Structural Considerations for Conduit Routing:
1. Where conduits are to pass through or will interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other building elements to accommodate the electrical work, such work shall conform to State Building Code, Title 24, for conduits and pipes embedded in concrete and for notches and bored holes in wood; for steel and when detailed on the Structural Drawings.
 2. Where a concrete encasement for underground conduit abuts a foundation wall or underground structure which the conduits enter, the encasement shall rest on a haunch integral with the wall or structure, or shall extend down to the footing projection, if any, or shall be doweled into the structures unless otherwise indicated. Underground structures shall include manholes, pull boxes, vaults or buildings.
- E. Electrically Operated Equipment and Appliances:
1. Equipment and appliances furnished by the Contractor:
 - a. The electrical work shall include furnishing and installing wiring enclosures for and the complete connection of all electrically operated equipment and appliances and any electrical control devices which are specified to be furnished and installed in this or other electrical Sections of the Specifications, except electrical work specified or indicated, to be in the Mechanical Work. All wiring enclosures shall be installed concealed, except where exposed work is indicated on the electrical drawings.
 - b. Connections shall be made as necessary to completely install the equipment ready for use. The equipment shall be tested for proper operation and, if motorized, for proper rotation. If outlets of incorrect electrical characteristics or if any equipment fails to operate properly, the Contractor shall report to the District's Inspector in writing, listing the buildings and rooms in which located, the name, make and serial number of the equipment, and a description of the defect.
 2. Equipment and appliances furnished by others:

- a. Equipment and appliances shown on the drawings as Not in Contract, Furnished by Others, or Furnished by the District, will be delivered to the Site. Required electrical connections shall be made for all such equipment and appliances in accordance with accepted trade practices under the direction of the District Inspector. All motorized equipment will be furnished factory wired to a motor starter or junction box, unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
 - b. Connections to equipment furnished under other Sections shall be part of the electrical Work. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit and connections only for equipment furnished with factory installed internal wiring, except as further limited by the drawings and other portions of the Specifications. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and the wiring necessary for a complete electrical installation. The work shall also include furnishing and installing the conduit and outlet box, if needed for the control system, furnished under Mechanical. Devices and equipment furnished shall be of the same type used elsewhere on the job or as specified.
 - c. Electrical equipment furnished under other Sections for installation and connection under work of this Section shall be delivered to the installation location by the Contractor furnishing the equipment.
 - d. Mechanical equipment furnished under other Sections and requiring electrical connection under this Section, will be set in place by Contractor furnishing the equipment.
 - e. Suitability and condition of equipment furnished by other Sections shall be determined in advance of installation. Immediate notice shall be given to the District of damage, unsuitability or lack of parts.
- F. Protection of materials:
1. Provide for the safety and good condition of all materials and equipment until final acceptance of the project by the District. Protect all materials and equipment from damage and provide adequate and proper storage facilities during the progress of the work. All damaged and defective work shall be replaced prior to final inspection.

GROUNDING SYSTEM REQUIREMENTS:

- A. Grounding shall be as approved by the State of California, Division of Industrial Safety.
- B. Electrical continuity to ground for metal raceways and enclosures, which are isolated from the equipment ground by use of non-metallic conduit or fittings, shall be provided with a Code sized green insulated grounding conductor within each raceway connected to the isolated metallic raceways or enclosures at each end. Each flexible conduit shall be provided with a green insulated grounding conductor of Code approved size.
- C. Cold water or other utility piping systems shall not be used as the main system grounding electrodes due to the possible use of insulating couplings and nonmetallic pipe in such installations. All grounding electrodes shall be made electrodes as indicated on the drawings. Within every building the panels shall be bonded to a 1" or larger underground cold water

- service line with minimum 1" conduit, and one No. 6 wire. All metallic piping systems (gas, fire sprinkler) shall be bonded to the cold water line with 3/4" conduit with one No. 8 wire.
- D. Non-current carrying metal parts of all high voltage, light and/or power, communications, control, and signal conduit systems, supports, cabinets, switchboards, enclosures, fixed equipment, portable equipment and motor frames shall be permanently and effectively grounded.
 - E. Service neutral conductors of light and/or power alternating current systems shall be grounded as indicated on the drawings and as required by the Utility Company.
 - F. Secondary neutral conductors of all light, power and signal alternating current systems shall be grounded.
 - G. Provide a "made electrode" bonded to the equipment enclosure at each separate building, including portable buildings, for each light and/or power system. Grounded (neutral) conductors shall be terminated at the neutral bus of the first panel or switchboard encountered within the building, and the neutral bus, equipment enclosure and "made electrode" shall be bonded together.
 - G. Cleaning:
 - 1. Exposed parts of the electrical work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be un-blemished and metal surfaces shall be polished.
 - 2. Thoroughly clean all parts of the apparatus and equipment. Exposed parts, which are to be painted, shall be thoroughly cleaned of cement, plaster and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped and all corners and cracks scraped out. Exposed rough metal work shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
 - 3. The Contractor shall remove from the Site all debris and rubbish occasioned by the electrical work. He shall thoroughly clean the building of dirt, debris, rubbish, and marks caused by the performance of the work.

1.03 SUBMITTALS:

Submit a material list in accordance with Section 01300.

PART 2 - PRODUCTS - Not used.

2.01 GROUNDING MATERIALS:

- A. Yard boxes for "made electrodes" shall be precast concrete as detailed on the drawings. Boxes shall be equipped with bolted down, checkered, cast iron covers and a cast iron frame cast into the box. Yard boxes shall be Brooks 36 or approved manufacturer.

- B. "Made electrodes" shall be approved copper clad steel ground rods, minimum 3/4" diameter 10' 0" long or a copper "Ufer" conductor encased in the concrete building foundation as indicated on the drawings.

2.01 RACEWAYS, FITTINGS AND SUPPORTS:

A. Conduit Materials:

1. Metallic conduit and tubing shall be manufactured under the supervision of Underwriters' Laboratory, Factory Inspection and Label Service Program. Each 10' length of conduit and tubing shall bear the Underwriters' Laboratory label and manufacturer's name.
2. Rigid steel conduit shall be heavy wall, mild steel, zinc coated, with an inside and outside protective coating. Couplings, elbows, bends and other fittings shall be the same materials and finish as the rigid steel conduit. Fittings, connectors, and couplings shall be threaded type.
3. Electrical metallic tubing shall be steel tubing, zinc coated with a protective enamel coating inside. Fittings, couplings and connectors shall be gland compression type. Electrical metallic tubing is designated herein after as "EMT".
4. Flexible steel conduit shall be of flexible interlocking steel strip construction with continuous zinc coating on the strips. Connectors and couplings shall be approved fittings of the type which thread into the convolutions of the flexible conduit or clamp type.
5. Liquid-tight flexible metal conduit shall be galvanized, heavy wall, flexible locked steel strip construction with a smooth moisture and oil proof, abrasion-resistant, extruded plastic jacket. Connectors shall be approved for use with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
6. Acceptable Manufacturers: Crouse Hinds or Appleton.
7. No metal clad (MC) cable allowed as alternate.

B. Sleeves for Conduits:

Sleeves shall be adjustable type, of 26 gauge galvanized iron, Adjusto Crete Company, Adjusto-Crete, or Jet Line Products Inc., Jet-Line.

C. Expansion Joints:

Where conduits embedded in masonry or concrete cross seismic separations between buildings, expansion joints or at locations indicated, the Contractor shall provide sliding or a sliding and deflecting fitting, as conditions require in each conduit. Sliding fittings shall be O-Z Electrical Manufacturer Company, Inc., Type AX, with bonding strap and clamps. At exterior locations use O-Z Electrical Manufacturer Company Inc., Type EX.

D. Penetration in Fire Rated Structures:

Provide Dow Corning No. 3-6548, RTV silicone foam for making fire rated seals around penetrations through floors or walls.

2.02 WIRES, CABLES AND CONNECTOR:

- A. Pull Wires: A 1/8" polypropylene cord shall be installed in each empty conduit. A 1/8" polypropylene cord shall be installed in each underground service conduit unless otherwise required by the utility company.

- B. 600 Volts or Less Wires:
1. Wire shall be NEC type THHN or THWN in sizes No. 4 and smaller and NEC type THWN in sizes No. 2 and larger, unless otherwise indicated. All wire shall have copper conductors. Wires No. 14 and larger shall be stranded. Wires smaller than 12 gauge shall not be used in the light and power systems.
 2. Wire adjacent to ovens and boilers, in range hoods, and at other dry locations where the operating temperature of the wire may be expected to exceed 60°C, but not to exceed 90°C, shall be National Electric Code Standard Type THHN. Where the temperature may be expected to exceed 90°C, wire shall be a type approved by Underwriters' Laboratory for the temperature and installed conditions involved, silicone type wire 200°C or equivalent.
- C. Color Code, Signal and Communications Systems:
- All wires for signal and communication systems shall be color coded per District standards and shall be installed under the direction of the District's Electrical Inspector. Request a copy of the District Standards for color coding prior to ordering wiring—black, red, blue, white – 208-240; brown, orange, yellow – 480/277.

2.03 BOXES, ENCLOSURES, KEYS AND LOCKS:

- A. Outlet Boxes and Fittings:
1. Outlet boxes used in concealed work shall be galvanized or sherardized steel, pressed or welded type, with knockouts.
 2. In exposed work, outlet boxes and conduit fittings required and where conduit runs change direction or size, shall be cast metal with threaded cast hubs cast integral with the box or fitting. Boxes and fittings shall not have unused spare hubs, except as otherwise indicated or approved manufacturer.
 3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium plated or zinc galvanized. The castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal and shall be free of cracks, gas holes, flaws, excessive shrinkage and burnt out sand.
 4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for the fitting with which used.
 5. Light fixture outlets shall be 4" octagon, 4" square, or larger, depending upon the number of wires or conduits therein, and shall be equipped with 3/8" malleable iron fixture studs, and plaster rings. Plaster rings shall have round opening with two ears drilled 2 23/32" center to center.
 6. For local switch outlets use 4" square boxes for single gang, 4 11/16" square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
 7. For all receptacle, clock, bell, fire station, speaker, security and telephone outlets, use 4" square boxes or larger with single gang plaster rings. For television outlets, use 4-gang deep boxes and 4-gang plaster rings. For communication switch, use 4" square boxes with single gang or larger plaster rings.
 8. Plaster rings shall be provided on all flush mounted outlet boxes, except where otherwise indicated or specified. All plaster rings shall be same depth as the finished surface.
 9. Factory made knock-out seals shall be installed to seal all box knock-outs, which are not intact.

10. At each location where flexible conduit is extended from a flush outlet box, provide and install a weatherproof universal box extension adapter by Bell Electric Company.
 11. No more than one box extension or cuffs used anywhere.
- B. Junction and Pull Boxes:
1. Junction and pull boxes, in addition to those indicated, shall only be used where absolutely necessary with the specific approval of the District's Electrical Inspector in each case.
 2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded and shall be rigid under torsional and deflecting forces. Boxes shall have auxiliary angle iron framing where necessary to ensure rigidity. Covers shall be fastened to the box with a sufficient number of brass or stainless steel machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws at the site if the boxes are not installed plumb. All surfaces of pull and junction boxes and covers shall be given one coat of metal primer, and one coat of aluminum paint, and shall have permanent labels with box designation or system or circuit numbers.
 3. Weatherproof pull and junction boxes shall conform to the foregoing for interior boxes with the following modifications: The cover of flush mounting boxes shall have a weather-tight gasket cemented to and trimmed even with the cover all around. Surface or semi-flush mounting pull and junction boxes shall be Underwriters' Laboratory approved as rain-tight and shall be complete with threaded conduit hubs. All exposed portions of boxes shall be galvanized and finished with a prime coat and standard coat of baked-on enamel. For underground pull-boxes, the cast iron cover shall be permanently marked Electrical, Power, Signal, Telephone or Ground.
 4. All junction and pull-boxes shall be rigidly fastened to the structure and shall not depend on the conduits for support.
- C. Floor Outlets:
1. All flush floor outlet boxes shall be adjustable, cast iron, set flush with the finished floor material, Hubble No. B-2503.
 2. Telephone, microphone and similar floor outlets shall be equipped with a brass cover plate with 2 1/8" flush cap, Hubble No. S-3061.
 3. Receptacle floor outlets shall be equipped with a flush brass cover plate with screw-in caps, appropriate for the type of receptacle shown on the drawings.
- D. Floor Pockets:
1. Single Gang: Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast iron box, C.W. Cole No. TLS-362-1-FE. Equip each pocket with a standard single grounding type receptacle, unless otherwise indicated. Use C.W. Cole No. TLA-362-1 in wood floors.
 2. Microphone, speaker or projector sound floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast iron box, C. W. Cole No. TLA-362-3-FE. Use C. W. Cole No. TLS-362-3 in wood floors.

2.04 RECEPTACLES AND SWITCHES:

- A. Receptacle shall be industrial Specifications grade, back and side wired with binding screws and plaster ears with captive mounting screws. Receptacle bodies shall be phenolic, plastic or bakelite with ivory colored faces, unless otherwise indicated. Receptacles shall have heavy duty, current carrying contacts and double wipe flat ground contacts. Receptacles shall be Hubbell, Arrow-Hart, Bryant or Leviton.
1. Duplex receptacles shall be 20 amps (NEMA 5-20R), 125 volts, two-pole, three-wire with parallel slots, U-ground.
 2. Single receptacles shall be of the voltage, rating and configuration shown on the drawings.
 3. Ground fault interrupting type receptacles shall consist of a duplex receptacle with a test and a reset device manufactured in a standard configuration for use with a duplex cover plate. Receptacles shall be 20 amps (NEMA 5-20R) or as indicated on the drawings. Exterior receptacles shall be weatherproof.
 4. Weatherproof receptacles, except where otherwise indicated or specified, shall consist of a duplex receptacle, as specified herein, and a metal plate with die cast hinged lid and weatherproof mat.
- B. Switches:
1. Local Switches:
 - a. Local switches shall be tumbler type, industrial specification grade, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for back and side wiring and standard size composition cups which fully enclose the mechanism. Switches shall be approved for use at currents up to the full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80% of the rating for motor loads. Switches shall be single pole, double pole, three-way, four-way, non-lock type, (or lock type when indicated). Non-lock type switches shall have ivory handles. Switch shall be Hubbell 1221I or approved manufacturer specified by the District.
 - b. All lock type switches shall have metal or nylon key guides with ON/OFF indication, and shall be operable by the same key. Keys for lock type switches shall be forked type, cut from 1/16" stock. Fork dimensions shall be: External 1/4", Internal 5/32", depth 3/16" and radius 5/64". Key switches shall be Hubbell 1221L only. Where pilot light is required for key switch see paragraph on Pilot Lights. Provide minimum ten keys to District.
 - c. Pilot light switches shall be rated 20 amps and shall conform to the Specifications for local switches. The switches shall have red, rugged lexan handles that are lighted by long lasting neon lamps. Pilot light shall light when load is on. Single pole, 120 volts wiches shall be Hubbell 1221-PL
 - d. Remote control switches for mechanically held contractors arranged for three-wire control shall be tumbler type, momentary contact, single pole, three-position with center "OFF" rated 20 amps at 120/277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose the mechanism and ivory handles. Lock type switches shall be Hubbell 1557L.
 2. Time Switches and Photo Electric Controls:
 - a. Time switches shall be 7-day Intermatic or approved manufacturer specified by the District.
 - b. Photo electric Control: Photo electric control shall be rated 2000 watts with single pole, single throw, normally closed contact, enclosed in a die cast aluminum gasket enclosure, Tork Series, Intermatic or approved manufacturer by the District.

2.05 IDENTIFICATION AND SIGNS:**A. Name Plates:**

1. The following equipment shall be provided with name plates unless otherwise specified: Switchboards, motor control centers, control panels, push button stations, time switches, contractors, motor starters, motor switches, relays, panel boards and terminal cabinets.
2. Name plates shall give equipment designation and adequately describe the function, voltage and phase of the particular equipment involved. For panel boards, the nameplates shall indicate the panel designation, voltage and phase of the panel. For terminal cabinets, the nameplates shall indicate the system housed therein.
3. Nameplates shall be black and white nameplate stock of bakelite with characters cut through the black exposing the white. Plates shall have beveled edges and shall be securely fastened in place with No. 4 Phillips head, cadmium plated steel, self tapping screws. Characters shall be 3/16" high, unless otherwise indicated.

B. Markings:

The following equipment and controls shall have markings: Pull and junction boxes, and other devices controlling motors and appliances. Abbreviations acceptable to the District's Electrical Inspector, along with an identifying number, shall be used. Markings shall be done with locking type stencils using paint of a contrasting color. Figures shall be 3/8" high unless otherwise indicated.

C. Warning Signs:

1. Provide a warning sign firmly secured to the outside of each door or gate to enclosures containing high voltage equipment over 600 volts A.C. The signs shall read: "Danger High Voltage Keep Out ". Signs shall be 7" x 14" with all lettering 1" high, except the word "Danger", which shall have 1 1/2" high letters.
2. Signs shall be of standard manufacturer 18 gauge steel, with porcelain enamel finish. Letters shall be red on white background.

RACEWAY AND CABLE LABELS

A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, California Electrical Code, and these Specifications.

B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.

1. Color: Black legend on orange field.
2. Legend: Indicates voltage and services.

C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is over-laminated with a clear, weather- and chemical-resistant coating.

D. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

- E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).
- F. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Size: Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
 - 2. Compounded for permanent direct-burial service.
 - 3. Embedded continuous metallic strip or core.
 - 4. Printed Legend: Indicates type of underground line.
- G. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- H. Aluminum, Wraparound Marker Bands: Bands cut from 0.0140-inch (0.4 mm) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- I. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- J. Aluminum-Faced Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, and punched for the fastener. Preprinted legends suit each application.
- K. Brass or Aluminum Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 x 2 inches (51 x 51 mm) x 0.05 inch (1.3 mm).

ENGRAVED NAMEPLATES AND SIGNS:

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, California Electrical Code, and these Specifications.
- B. Engraving stock, melamine plastic laminate, 1/16-inch (1.6 mm) minimum thick for signs up to 20 sq. in. (129 sq. cm), 1/8-inch (3.2 mm) thick for larger sizes.
 - 1. Engraved Legend: Black letters on white face.
 - 2. Punched for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch (6.4 mm) grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396 inch (1 mm) galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch (6.4 mm) grommets in corners for mounting.

- E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.04 MISCELLANEOUS IDENTIFICATION PRODUCTS:

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength: 50-lb. (22.3 kg) minimum.
 - 3. Temperature Range: Minimum 40 to 185 degrees F (minimum 4 to 85 degrees C).
 - 4. Color: As indicated where used for color-coding.
- B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION OF EQUIPMENT AND APPLIANCES:

- A. Conduit stubs for equipment shall be terminated in a coupling flush with the finished floor and shall be extended with minimum 6" high rigid conduit to a motor starter, receptacle, or junction box. Flexible conduit as applicable shall be installed from the rigid conduit to motors and other vibrating equipment.
- B. If the connection is from a flush wall-mounted junction box, install a weatherproof universal box extension and adaptor by Bell Electric Company, and extend with rigid steel conduit to the motor starter or junction box on the equipment.
- C. All exposed final connections to equipment shall be by a water tight flexible metal conduit, unless otherwise indicated. A maximum of 36" of flexible metal conduit may be used except that all extensions from the flush floor couplings shall be rigid conduit to a distance not less than 6" above the floor.
- D. Flexible conduit for all motors, cafeteria equipment and other equipment, including HVAC equipment, shall be liquid-tight flexible metal conduit and shall contain a Code size insulated green bond wire.
- E. All exposed conduit shall be run vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to the equipment with suitable iron brackets and one-hole pipe straps.

- F. Connectors for flexible steel conduit shall be the type, which threads into the convolutions of the conduit or clamp type. Connectors for water-tight flexible metal conduit shall be approved for such use and shall be installed to make a watertight connection.

3.01 INSTALLATION OF GROUNDING EQUIPMENT:

- A. Grounding "made electrode" rods shall be located in the nearest usable planting area, where not otherwise indicated on the drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, concrete yard box shall be 2" above planting surfaces.
- B. Rods shall be driven to a depth of not less than 8' 0". Electrodes shall have a resistance to ground of not more than 25 ohms if practicable. If the resistance exceeds 25 ohms, two or more electrodes connected in parallel shall be provided. The minimum number and size of ground rods shall be as required by State Electrical Safety Orders. Electrodes shall be separated from one another by not less than 6' 0". Parallel electrodes shall be connected together with approved fittings and approved grounding conductors in galvanized rigid steel conduit, buried not less than 12" below finish grade.

The grounding resistance shall be tested by an approved independent testing laboratory in the presence of the District Inspector, District Electrical Maintenance Supervisor and the District Engineer. The test results shall be submitted to the District Maintenance Supervisor on an official form for file with copies distributed to the District Inspector and Electrical Consulting Engineer

3.01 CONDUIT INSTALLATION:

- A. General Requirements:
 1. Provide complete and continuous systems of rigid steel conduit, outlet boxes, junction boxes, fittings and cabinets for all systems of electrical wiring including lighting, power, communications, control and signal systems, except as otherwise specified.
 - a. Site electrical distribution conduit sizes shall be:
 - 1.) Electrical power and lighting, and control systems distribution - 1" minimum.
 - 2.) Signal and communications distribution - 2" minimum and separate conduit for each system.
 - b. Site underground pullboxes minimum – Christy N30.
 2. Within buildings EMT may be used in lieu of rigid steel conduit where permitted by ordinance. EMT shall not be used in the following cases: exposed below 8 feet elevations; in concrete; underground.
 3. Within buildings flexible steel conduit may be used in lieu of rigid steel conduit where permitted by ordinance, but no metal clad (MC) cable. Flexible steel conduit shall not be used for runs longer than 6 feet or for exposed conduits.
 4. Flexible steel conduit shall be used, except where otherwise specified, for final connection of all motor terminal boxes and shall be of sufficient length (not to exceed 36") to allow full travel or adjustment of the motor on its base.

5. Underground feeder distribution conduits for all systems may be nonmetallic polyvinyl chloride (PVC) Schedule 40 conduit in lieu of rigid steel conduit, except where otherwise specified or indicated.
6. Conduit shall be concealed, unless otherwise indicated. Conduits exposed to view (except those in attic spaces and under buildings) shall be installed parallel or at right angles to structural members, walls, or lines of the building. Conduits shall be routed to clear access openings.
7. Bends or offsets will not be permitted, unless absolutely necessary. The radius of each conduit bend or offset shall be as required by ordinance, except for underground conduits, for public telephone conduits, and where otherwise indicated or specified. Bends and offsets shall be made with standard tools and equipment made especially for the purpose or may be factory made bends or elbows complying with the requirements for radius of bend specified herein. Public telephone conduit bends and offsets shall have a radius, which is not less than ten times the trade size of the conduit, unless otherwise approved by the telephone company. Refer to "Underground Conduit Installation" for the radius of bends and offsets required for underground installations.
8. Running threads will not be permitted. Provide approved conduit unions where union joints are necessary. Conduits shall be kept at least 6" from the coverings on hot water and steam pipes and 18" from flues and breechings. The open ends of conduits shall be kept closed with approved conduit seals during construction of the buildings and during the installation of underground systems.
 9. The joints in conduits installed in concrete, wet locations, exposed to the weather or underground shall be made liquid tight.
 10. Conduits run exposed on roofs shall be rigid conduit (no EMT).
 11. Where auxiliary supports, saddles and brackets are required to meet special conditions, they shall be made rigid and secure before the conduit is attached thereto.
 12. Conduit in ceiling spaces, in stud walls and under floors, shall be supported with factory made pipe straps or shall be suspended with pipe hangers or pipe racks. The pipe straps shall be attached to and shall hold the conduit tight at the point of support against the ceiling, floor joists, rafters, wall studs or 2" x 4" headers fitted between the joists or wall studs.
 13. Conduits installed on exposed steel trusses and rafters shall be fastened with factory made conduit straps or clamps, which shall hold the conduit tight against the supporting member at the point of support.
 14. Conduits under buildings shall be buried below the surface of the ground.
 15. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, and shall securely hold the conduit, or shall be springable wrought steel. Rings shall be bolted to or interlocked with the suspension rod socket. Rods shall be 3/8" for 2" conduit hangers and smaller and shall be 1/2" for 2 1/2" conduit hangers and larger.
 16. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapezed type and shall consist of a cross channel, Steel City Kindorf No. B-900 or Unistrut No. P-1000 suspended with a 3/8" minimum diameter steel rod at each end. Each rod shall be fastened with nuts, top and bottom to the cross channel and with a

square washer on top of the channel. Each conduit shall be clamped to the top for the cross channel with conduit clamps, Steel City Kindorf No. C-105 or Unistrut Nos. P-1111 through P-1124. Conduits shall not be stacked one on top of the other, but a maximum of two tiers may be on the same rack by providing an additional cross channel. Where a pipe rack is to be longer than 18" or if the weight it is to support exceeds 500 pounds, submit details of the installation to the Architect for approval.

17. Conduits, which are suspended on rods more than 2' long, shall be rigidly braced per State Seismic Regulations to prevent horizontal motion or swaying.
18. Factory made pipe straps shall be one- or two-hole formed galvanized clamps, heavy duty type, except as otherwise specified.
19. Hangers, straps, rods or pipe supports under concrete shall be attached to inserts set at the time the concrete is poured. Under wood, use bolts, lag bolts or lag screws; under steel joists or trusses, use beam clamps.
20. Conduits shall be supported at intervals required by ordinance, but not to exceed 10'. One inch and smaller conduits installed exposed shall be fastened with 2-hole straps. Perforated strap and plumber's tape shall not be used in the support of conduits.
21. Each conduit stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. The base of the flashing shall extend on the roof not less than 10" from the conduit. Flashing shall extend up the conduit not less than 6" and shall be in contact with the conduit for minimum 1" at the top. Refer to Division 7, Sections 07310, 07510, and 07541.
22. Bushings for all sizes of rigid steel conduits shall be threaded insulating type. Set screw bushings are not acceptable.
23. All flex conduits shall be cut square and not at an angle.
24. It shall be the responsibility of the Contractor to install the conduits with a minimum number of bends in such a manner as to conform to the structure and meet all applicable code requirements.
25. The routing of conduits may be changed if approved by the District Inspector, providing the length of any conduit run is not decreased more than 10% of the length shown on the drawings.
26. Minimum size conduit for all signal and communication systems shall be 3/4".
27. A minimum of two 1" conduits shall be installed (stubbed) into nearest accessible ceiling space from each panelboard, terminal cabinet, distribution panelboard, backboard or switchboard. Cap conduits with appropriate conduit caps.
28. Conduits installed vertically on the outside surface of buildings shall be strapped tight to the building surface with no space behind.

B. Underground Requirements:

1. ~~All conduits installed underground shall be entirely encased in concrete 3" thick on all sides with multiple conduits spaced not less than 1 1/2" apart, unless otherwise specified. Provide approved conduit spacers as required to prevent any deflection of the conduits when concrete is poured and to preserve the position and alignment of the conduits in the concrete. Conduits shall be tied to the spacers. Anchors shall be installed to prevent floating of conduits during pouring of concrete. Red colored concrete shall be used to encase conduits of systems operating above 600 volts.~~
2. All underground conduits shall be buried to a depth of not less than 24" below finished grade to the top of the concrete envelope, unless otherwise specified.

3. Assemble the sections of conduit with approved fittings and stagger all joints. Cut ends of conduit shall be reamed to remove all rough edges. The joints in all conduits shall be made liquid tight. All bends at risers shall be completely below the surface where possible.
 4. Two or more conduit runs in a common trench shall be separated by at least 1 1/2" of concrete. Electric conduit runs installed in a common trench with other utility lines shall be separated from such lines by at least 12" horizontally. Public telephone conduits shall be separated from electric conduits or other utility lines by not less than 3" of concrete, 2' horizontally and 1' vertically.
 5. The District's Electrical Inspector shall be called to the site for approval of all underground installations before and during concrete pour. Where considered necessary by the District's Electrical Inspector, a mandrel shall be drawn through each run of conduit in the presence of the Inspector, before and after pouring concrete. The mandrel shall be 6" in length minimum and have a diameter which is within 1/4" of the diameter of the conduit to be tested.
 6. Nonmetallic conduit installations shall comply with the following additional requirements: All joints in PVC conduit shall be sealed by means of approved solvent-weld cement supplied by the conduit manufacturer. All nonmetallic conduit bends and deflections shall comply with the requirements of the applicable Electrical Code, except that the minimum radius of any bend or offset for conduits sized from 1/2" to 1 1/2" inclusive shall not be less than 24". All 90° Ell's, 1" and larger, shall be rigid conduit. All 90 degree bends, bends at risers, and the risers shall be rigid steel conduit and shall comply with the requirements specified herein for underground rigid steel conduit installations. The radius of the curve of any bend or offset in non-metallic conduit for the Public Telephone System shall be not less than ten times the trade size of the conduit, unless otherwise specifically approved by the Public Telephone Utility Company.
 7. Rigid steel conduit installations shall comply with the following additional requirements: Where sweeps are specified or indicated, the radius shall be not less than 10'. The radius of the curve of the inner edge of any bend or offset shall be not less than is permitted in the Conduit Bend Radii table for rigid steel conduit field bends in the applicable Electrical Code, unmodified by any exemptions, bulletins, or amendments. The radius of the curve of bends or offsets for the Public Telephone System shall be not less than ten times the trade size of the conduit, unless otherwise specifically approved by the Telephone Utility Company. Rigid conduit underground to be double wrapped with 10 mill tape.
- C. In Slabs on Grade:
1. Unless specifically approved by the Office of the State Architect, conduits 1 1/4 size and larger shall not be installed in structural concrete slabs. Where conduits are permitted, and are installed in concrete slabs on grade, the slabs shall be thickened at the bottom where conduits occur to provide 3" of concrete between the conduit and earth. Conduits shall clear all rebar. The required excavation shall be part of the work of this Section.
 2. If the concrete slab is 5" or more in thickness with a moisture barrier plastic sheet between the earth and the slab, the 1" and smaller conduits shall be installed in the slab with a minimum of 1" concrete between earth and conduit.
- D. Penetration in Concrete Walls, Beams and Floors: Provide sleeves where conduits pierce concrete walls, beams and floors, except floor slabs on earth. Sleeves shall have 1/2" clearance around conduits. Sleeves shall not extend beyond the exposed surfaces of the concrete and shall be securely fastened to the forms. Where conduits pass through walls below grade, call

with District approved sealant and provide backer materials between the conduit and the sleeve to obtain a water tight joint.

3.02 STUBS:

- A. Floor: At each point where floor stubs are indicated in open floor areas for connections to equipment, the conduits shall be terminated with couplings, the tops flush with the finished floor. Stubs shall extend above the couplings the indicated distance, but in no case less than 6" high. Where capped stubs are called for, the couplings shall be closed with cast iron plugs with screw drive slots.
- B. Underground:
 - 1. Underground conduit stubs shall be terminated at the locations indicated, but minimum 5' beyond building foundations, steps, arcades, concrete walks and paving, unless otherwise noted. Rigid steel conduit stubs and nonmetallic conduit stubs shall be capped by installing a coupling flush in the end wall of the concrete encasement and plugging with an approved plug or terminated stub in a concrete box (Christy). The As-Built Record drawings shall show the location of the ends of underground conduit stubs fully dimensioned with reference to the buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on the "As-Built" Record Drawings in the presence of the District's Inspector before backfilling in the trench.

3.03 WIRE INSTALLATION:

- A. Wire shall not be installed until all plastering throughout the building is completed, and all debris and moisture removed from the conduits, boxes, and cabinets.
- B. Wire-pulling compounds used as lubricants in installing conductors in raceways shall only be compounds approved and listed by Underwriters' Laboratory. No oil, grease, graphite, or similar substances may be used. Pulling of No. 1/0 or larger conductors shall be done only with an approved cable pulling machine.
- C. The District's Inspector shall be called to the site and shall supervise the installation of all feeder cables. The District shall be notified not less than two working days in advance of the proposed time of installation.
- D. At all outlets for light, power, communications, control, and signal equipment, pigtail splices with 8" circuit conductor leads shall be provided for connection to fixtures, equipment and devices.
- E. Pressure cable connectors, pre-insulated "Scotchlok" Type "Y", "R", or "B" spring loaded twist-on type, may be used for splicing 8 gauge or smaller conductors, in lieu of soldered connectors for all wiring systems, except the public address, District owned telephone system, or system clocks.
- F. All joints, splices, taps and connections for cables 6 gauge and larger, shall be made with high-pressure cable connectors approved for use with copper conductors.

- G. Wire in switchboards, panels, terminal cabinets, pull boxes and other cabinets (except public address) shall be neatly grouped and tied in bundles with nylon ties at 10" maximum intervals. At switchboards, panels and terminal blocks, wires shall be fanned out to the terminals.
- H. Each neutral conductor larger than 6 gauge which is not color identified throughout its entire length shall be painted white or taped white wherever it appears in a switchboard, cabinet, gutter or box. Neutral conductors 6 gauge and smaller shall be white color identified throughout their entire length.
- I. All systems of wiring shall be so installed that when completed, the systems will be free from short circuits and from grounds, other than required grounds. The Contractor shall provide all instruments for testing and shall demonstrate in the presence of the District's Electrical Inspector that each system of wiring meets the following minimum requirements for insulation resistance:
 - 1. For circuits of No. 12 AWG wiring or smaller: 1,000,000 ohms.
 - 2. For circuits of No. 10 or larger conductors, a resistance shall be based on the following allowable current-carrying capacities of conductors:

25 to 50 amperes inclusive	250,000 ohms
51 to 100 amperes inclusive	100,000 ohms
101 to 200 amperes inclusive	50,000 ohms
201 to 400 amperes inclusive	25,000 ohms
401 to 800 amperes inclusive	12,000 ohms
Over 800 amperes inclusive	5,000 ohms
 - 3. The above values shall be obtained with all switchboards, panel boards, fuse holder, switches, and overcurrent devices in place and connected, and with all switches closed.
 - 4. If lamp holders, receptacles, fixtures and appliances for a system are also connected, the minimum insulation resistance permitted shall be one-half the values specified above.
- J. The Contractor shall provide a "Meager" insulation tester, which will apply a minimum of 500 volts direct current for these tests when requested by the District's Inspector.
- K. 120 volts and 277 volts circuits shall be routed in separate conduits, raceways and enclosures.
- L. Other conductors in raceway or cable: Conductors, other than service conductors, shall not be installed in the same service raceway or service cable.

All low voltage wiring regardless of insulation voltage rating shall be in a separate raceway. It shall not be in the same raceway or pullbox with systems 100 volt or more.

3.04 FEEDER IDENTIFICATION:

Lighting, power, and low voltage feeder wires and cables shall be identified at each point of termination and at each point the conduit run is broken by a cabinet, box and gutter. Identification shall be by means of wrap around type markers, E-Z Code or Brady Perma-Code, and shall include the feeder designation, size and description.

3.05 TAPE:

Splices, joints and connectors joining conductors shall be covered with insulation equivalent to that on the conductors. Free ends of conductors connected to an energized source shall be taped. The voids in irregular connectors shall be filled with insulating compound before taping. Thermo plastic insulating tape approved by Underwriters' Laboratory for use as the sole insulation of splices shall be used and shall be applied according to the manufacturer's printed specifications. Heat shrink tubing may be used as per manufacturer's specifications.

3.06 BOXES INSTALLATION AND SUPPORT:

- A. Outlet boxes shall be flush with finished surface of wall or ceiling. They shall be plumb and securely fastened to the structure independent of the conduit. Except where otherwise indicated, factory made bar hangers shall be used to support outlet boxes.
- B. Outlet boxes installed in ceilings suspended or furred with steel runner and/or furring channels shall be supported (except where otherwise indicated) by a Unistrut No. P-4000 channel spanning the main ceiling runner channels. Each box shall be supported from its channel by a 3/8" 16 threaded steel rod with a Unistrut No. P-4008 nut and a Tomic No. 711-B Adapta-Stud. The rod shall be tightened to a jamb fit with the channel and its nut. The box shall be locked to the rod by means of a 1/2" locknut on the stud and a 3/8" 16 hex nut locking the stud to the rod.
- C. The heights of outlets and equipment indicated on the drawings shall govern, but in the absence of such indications, the following heights shall be maintained. Heights are to centerline from finished floor surface, unless otherwise noted:
 - 1. Communication switch, pushbutton, light switch, other switches, and fire station outlets: 48".
 - 2. Bell and/or horn outlets in corridors: 12" below ceiling.
 - 3. Clock, speaker, and bell outlets in classrooms and offices: 8' 0".
 - 4. Outside bell and yard light outlets: 12" below the top plate level for one-story buildings without covered porch or arcade, and 12" below covered porch and arcade ceilings.
 - 5. Desk public telephone, television, desk interphones, and receptacle outlets 12".
 - 6. Panel boards and terminal cabinets: 6' 6" to top.
- D. Receptacle outlet boxes shall not be located within 6' of water sinks, except where a ground fault interrupter circuit breaker or ground fault type receptacle is provided to protect receptacle outlets located within 6' of water sinks.

3.07 PLATES:

- A. Provide an appropriate plate on each outlet. Plates shall be of stainless steel, unless otherwise specified. Public telephone plates shall have single bushed openings. Sectional plates will not be accepted.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless steel plates. Flush lighting outlets to be capped shall be covered with Wire

mold No. 5736 steel covers, painted to match the surrounding finish. Surface-mounted outlets indicated to be capped shall be covered with blank stainless steel covers.

- C. Switch and receptacle plates shall be provided with engraved designations under any one of the following:
 - 1. Pilot Switches.
 - 2. Switches so located that the operator cannot see one of the fixtures or items for equipment controlled with his hand on the switch.
 - 3. Switches not in the same room with the fixtures or items of all unit heaters, air curtains, fly fans, and exhaust fans.
 - 4. Receptacles operating at other than 120 volts.
 - 5. Where so indicated on the drawings.
- D. The designations shall be as indicated on the drawings or as specified and shall be engraved in the plates with 3/16" high block type letters filled with black enamel. Where designations are not indicated or specified they shall be requested from the Engineer. For estimating purposes, they may be assumed 12", not to exceed more than ten letters per gang.

3.08 IDENTIFICATION OF CIRCUITS AND EQUIPMENT:

- A. Switchboards, motor control centers, transformers, panel boards, circuit breakers, disconnecting switches, starters, pushbutton control stations and other apparatus used for the operation or control of circuits, appliances or equipment, shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus or wiring.
- B. Nameplates shall be engraved laminated bakelite. Shop Drawings with dimensions and format shall be submitted to the District or Architect for approval before installation. Attachment to equipment shall be with self-tapping screws. Self-adhering or adhesive backed nameplates shall not be used.
- C. Tags shall be attached to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Circuit, phase and function shall be indicated. Branch circuits shall be tagged in distribution boards, panel boards, and motor control centers. Tags shall be made of pressure sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Cardholders and cards shall be provided for circuit identification in panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit, area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when shown on the drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name as described in part 2A shall be correctly engraved with a legend showing function or areas when required by Codes or shown on the drawings.

G. Provide identity tags as to source and destination of all underground feeder cables in underground boxes.

H. Underground feeder cables not to exceed 200 feet without a pull box.

3.08 ELECTRICAL IDENTIFICATION INSTALLATION:

A. Install identification devices according to manufacturer's written instructions.

B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.

F. Install painted identification as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime Surfaces: For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.

3. Apply one intermediate and one finish coat of silicone alkyd enamel.

4. Apply primer and finish materials according to manufacturer's instructions.

G. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of the systems listed below for identification.

1. Bands: Pretensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, complete encircling conduit, and place adjacent bands of two-color markings in contact, side by side.

2. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15 m) maximum intervals in straight runs, and at 25 feet (7.6 m) in congested areas.

3. Colors—as follows:

a. Fire-Alarm System: Red.

b. Fire-Suppression Supervisory and Control System: Red and yellow.

c. Combined Fire-Alarm and Security System: Red and blue.

d. Security System: Blue and yellow.

e. Mechanical and Electrical Supervisory System: Green and blue.

f. Telecommunications System: Green and yellow.

H. Install Circuit Identification Labels on Boxes: Label externally as follows:

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card-stock tags.
3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

- I. Identify Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communications lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where multiple lines installed in a common trench or concrete envelop, do not exceed an overall width of 16 inches (400 mm); use a single line marker.
 1. Limit use of line markers to direct-buried cables.
 2. Install line marker for underground wiring, both direct buried and in raceway.

- J. Color-Code Conductors: Secondary service, feeder, and branch circuit conductors throughout the secondary electrical system.
 1. 208/120-V System--as follows:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 2. 480/277-V System--as follows:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Grey.
 - e. Ground: Green.
 3. Factory-apply color the entire length of the conductors, except the following field-applied, color-coding methods may be used in lieu 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 (150 mm) from terminal points and in boxes where splices or taps or made. Apply the last two turns of tape with no tension to prevent possible unwinding. Use 1-inch (25 mm) wide tape in colors as specified. Adjust tape bands to avoid obscuring cable identification markings.
 - b. Colored cable ties applied in groups of 3 ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.
 4. For all system voltages:
 - a. Isolated ground conductors: Green with yellow stripe.
 - b. Mark with a 1" band of green tape, followed by a 1" band of yellow tape, followed by a 1" band of green tape.

- K. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms.
 1. Legend: 1/4 inch (6.4 mm) steel letter and number stamping embossing with legend corresponding to indicated circuit designations.
 2. Fasten tags with nylon cable ties; fasten bands using integral ears.

- L. 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 for voltage and phase indication of secondary circuit.
 - 3. Multiple control communications 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.

- M. Apply warning, caution, and instruction signs and stencils as follows:
 - 1. Install warning, caution, and instruction signs where indicated or required 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 or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 - 2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8 inch (9 mm) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

- N. Install Identification as follows:
 - 1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2 inch (13 mm) high lettering on a 1 1/2 inch (38 mm) high label; where two lines of text are required, use lettering 2 inches (51 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment.
 - a. Panel boards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - e. Motor control centers.
 - f. Motor starters.
 - g. Push-button stations.
 - h. Contactors.
 - i. Remote-controlled switches.
 - j. Dimmers.
 - k. Control devices.
 - l. Transformers.
 - m. Telephone switching equipment.
 - n. Clock/program master equipment.
 - o. TV/audio monitoring master station.
 - p. Fire-alarm master station or control panel.
 - q. Security-monitoring master station or control panel.

2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, push-buttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panel boards and alarm/signal components where labeling is specified elsewhere. For panel boards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

END OF SECTION

SECTION 262000
ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included:

1. Provide all underground service conduits from the Utility Company's service point to the projects service equipment as indicated on the drawings and herein specified.
2. The Contractor shall consult the Utility Company before submitting bid to determine the exact location of the serving point and the work and material. The Contractor is required to leave the service installation complete and ready for cable installation without additional cost to the District. The service cable will be provided by the Utility Company and will be paid for by the District.
3. All work shall comply with the requirements of the Utility Company. Where required and indicated on the drawings, install outdoor transformer enclosure, pad and slab box, pull boxes or other equipment related to the service.
4. Transformers:
 - a. Transformers as specified and as indicated.
 - b. Provide mounting and seismic anchorage for all transformers complying with regulations of the State of California.

B. Switchboards and Protection Devices work Included:

1. Furnish, install and connect the switchboard, including metering facilities as required by the Power Utility Company.
2. All switchboards shall be complete with pull, service and distribution sections.
3. All protective devices shall have a minimum symmetrical short circuit interrupting rating, as described by the Utility and as indicated on the drawings complying with regulations of the State of California.
4. Provide mounting and seismic anchorage for all switchboards.

C. Panelboards Work Included: Lighting and power distribution facilities, including panel boards.

D. Motor Control and Control Devices Work included:

1. The connection to the terminals of motors, the furnishing and installation of disconnect switches, motor starters and control devices for motors.

D. Related Work:

1. Basic Electrical Requirements and Materials.
3. Excavating, Backfilling and Compacting.
4. Concrete.

1.02 REQUIREMENTS:

- A. Comply with the requirements of the Utility Company having jurisdiction.
- B. The interrupting capacity of the main circuit breaker and distribution circuit breakers shall be equal to or greater than the available short circuit current at the point as obtained by the Utility Company or computed by the Engineer. Selective coordination between main and all other feeder circuit breakers throughout the distribution system is required by the approved manufacturer of electrical power distribution equipment.

1.02 TRANSFORMER REQUIREMENTS:

- A. Transformers, Dry Type: Distribution transformers shall be constructed and tested in accordance with ASA and NEMA Standards, and shall be wound with copper conductors. Performance of transformers shall be equal to or exceed ASA and NEMA published criteria.
- B. Transformers shall be self-cooled type with Class H, NEMA, Group 111 insulation and a temperature rise of 150° C under continuous full load conditions with an ambient of 400° C.

Transformers supplying voltage to wave altering devices (computers, electronic ballasts, etc.) shall be K rated.
- C. Transformers shall be equipped with four 2 1/2% taps (2 above and 2 below normal voltage). Windings shall be of the fire-resistant type, designed for natural convection cooling through normal air circulation.
- D. Core mounting frames and enclosures shall be of welded and bolted construction with sufficient mechanical strength and rigidity to withstand shipping, erection and short circuit stresses.
- E. Enclosure cover plates shall be Code gauge sheet steel, captive bolted to the enclosure framework. Enclosure shall have suitable ventilating openings with rodent-proof screens. Enclosure shall be provided with lifting lugs and jacking plates as required.
- F. Transformers shall be furnished complete with mounting channels and mounting bolts. Metal parts, except cores and core mounting frames, shall be cleaned, rust-proofed and given a heavy coating of an inert primer.
- G. Transformers used indoors shall be "low noise." They shall be provided with vibration dampers. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.

1.03 MOTOR CONTROL AND DEVICES REQUIREMENTS:

Motor running protection of the manual reset type, as a separate device or as part of a motor starter and set at not to exceed 125% of the motor full load current rating, shall be provided for each motor exceeding 1/8 HP in size, except where indicated otherwise and except for the following: Motors of sufficient impedance to prevent overheating or failure to start (such as clock motors), and motors provided with an approved built in manual reset type device, responsive to

motor current and set at not to exceed 125% of the motor full load current rating, which will interrupt all current to the motor.

1.04 SUBMITTALS:

- A. All submittals shall be made in accordance with Section 01300.
- B. Product Data: Submit catalogs indicating make, capacity, size and catalog number for disconnect switches, motor starters and control devices.
- C. Shop Drawings: Include make, catalog number, dimensions, finish, type, insulation, class design temperature and taps provided. Include regulation at 80% and 100% of full load, no load loss, full load loss, percent efficiency, percent impedance, noise level and continuous capacity rating. Provide a connection schematic.
- D. Test Reports:
 - 1. No-Load Losses.
 - 2. Total Losses.
 - 3. Applied Voltage.
 - 4. Temperature Rise.
 - 5. Induced Voltage.
 - 6. Sound Level.
 - 7. Impulse Test.
- E. Transformer Submittals:
 - 1. Include a front elevation showing the dimensions and the locations of the equipment on the switchboard, the make, kind and size or capacity of all equipment and bussing, the location of each service conduit entering the switchboard, all barriers, nameplate inscriptions, finish, total weight, size of switchboard, and locations and sizes of anchor bolts.
 - 2. Coordination curves shall be provided by the manufacturer for the main circuit breaker and all distribution circuit breakers in the power and lighting electrical distribution systems.
- F. Record Drawings:
 - a. Provide a single reproducible drawing of the project as installed, showing all circuit numbers.
- G. Panelboards Shop Drawings: Include a front elevation, indicate circuit numbers, devices and ratings, cabinet dimensions, make, ratings, nameplate, location and capacity of equipment, size of gutters, type of mounting, finish and catalog number of locks.

1.04 DESIGN REQUIREMENTS:

- A. Lighting and Appliances Panel boards:
 - 1. Lighting and appliance panel boards shall be wall-mounted, enclosed, safety type with 277/480 volts, 4-wire or 120/208 volts, 4-wire surface or flush mounting, neutral mechanical equipment ground and main as indicated on the drawings or specified. First panel boards of each separate building shall be provided with main and/or sub-feeder circuit breakers where so indicated or specified.
 - 2. Single-pole branches for 120/208 volt panels shall be molded case, bolt on, thermal magnetic circuit breakers with inverse time delay, trip-free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be rated 20 amps, 120 volts,

except where otherwise indicated on the drawings, and the amp rating shall be marked on the handle and indicate "ON - OFF" and tripped positions. Single-pole branches for 277/480-volt panels shall be the same as for 120/208-volt panels, except they shall be thermal magnetic circuit breakers only with higher voltage rating. Ground fault interrupters shall be incorporated into circuit breakers where indicated and shall be listed by Underwriters' Laboratory as a ground fault device.

3. Two- and three-pole branch circuit shall be enclosed and shall be bolt-on, thermal magnetic with inverse time delay, non-tamperable, ambient compensated, single handle with no tie-bar, common-trip, quick-make and quick-break mechanism with silver alloy contacts. Circuit breakers shall be rated as indicated on the drawings.
 4. Main and subfeeder circuit breakers shall be enclosed, bolt-on thermal magnetic type with inverse time delay, single-handle common-trip, quick-make, quick-break mechanism, corrosion resistant bearings and silver alloy contacts. Amp frame size and trip rating shall be as indicated on the drawings. Breakers over 225 amperes shall have interchangeable trip units. The handles of main and subfeeder circuit breakers shall be under the cabinet door. Voltage rating shall be as indicated on the drawings.
 5. All circuit breakers shall be one-piece, bolt-on type and shall meet the short circuit interrupting capacity requirements shown on the drawings. All one-pole, two-pole, three-pole circuit breakers shall be rated for minimum 10,000 amps interrupt capacity, unless otherwise indicated on the drawings.
 6. All internal connections shall be made with plated copper bus bars, and the busses shall extend for the full length of the space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. All terminals shall have copper conductors. Panel boards fed by conductors having over-current protection greater than 200 amps shall be protected on the supply side by over-current devices having a rating not greater than that of the panel board.
 7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to the bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on the busses. Each single-pole branch shall be numbered adjacent to its circuit breaker with odd numbers on the left and even numbers on the right.
 8. All specified circuit breaker spaces shall include necessary hardware required for future installation of the circuit breakers.
- B. Panel board Cabinets:
1. Panel board cabinets shall be Code gauge galvanized steel or blue steel; fronts, doors, and trims shall be code gauge furniture steel. The width of the cabinets shall be 20".
 2. Doors shall be cut true, shall accurately fit opening and finish smooth across the joints. Rabbets shall be inside. The hinges shall be entirely concealed, except for barrels and pins. Hinge flanges shall be welded to the door and trim. Each door shall be equipped with flush type lock, spring latching, Corbin lock for metal door, keyed to Yale LL 803 or LL 134.
 3. Where contactors, time switches and control devices are specified or indicated to be installed within panel board cabinets, a separate compartment and lockable door shall be provided at the top of the cabinet for such devices. The door shall be sized as required to permit removal of the contactor and other devices intact. Gutters shall be provided at the sides and top of the compartment.

C. Panel Board Schedule:

The Contractor shall prepare a neatly type written schedule with the number or name of the room or area of the equipment served by each panel board circuit. The room numbers or names used shall match those as determined at the site and shall not necessarily be those used on the drawings. The schedule shall also indicate the panel designation, voltage and phase, the building and distribution panel or switchboard from which it is fed. The schedule shall be mounted in a frame under transparent plastic 1/32" thick on the inside of each panel board cabinet door.

D. Signal and Communication Terminal Cabinets:

1. All terminal cabinets shall conform in every respect to the Specifications for Panel board Cabinets, except as modified herein.
2. All terminal cabinets shall be flush type, unless otherwise noted, with 2" trim and separate door with lock over each section, unless otherwise indicated or specified. Cabinets shall be provided with barriers to separate each system. Cabinets over 24" in width shall be provided with double door and lock. Each terminal cabinet, or section of a terminal housing a separate system, shall measure 12" wide x 18" high x 5 3/4" deep, unless otherwise indicated on the drawings. Trims for sectional cabinets shall be of one-piece construction.
3. All terminal cabinets shall be equipped with 1/2" thick plywood backboards within the cabinets, and fastened in place with machine screws. Backboards shall be the largest size the cabinet and conduit terminations will permit.
4. Flush mounting terminal cabinets shall be finished as specified for flush mounting panel board cabinets. Surface mounted terminal cabinets shall be finished as specified for surface mounting panel board cabinets.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Transformer Pads: Concrete transformer pads shall be provided as indicated on the drawings and as specified under the Concrete Section of the Specifications.
- B. Service Conduits: As described under Section 16050 for utility wiring and must comply with all Utility Company's requirements.

2.02 TRANSFORMER EQUIPMENT:

- A. Transformers shall be by Square D, General Electric, or equal dry type (interior) all- copper windings.

2.03 SWITCHBOARDS:

- A. General Description: Switchboards shall be the products of Square D, General Electric or equal, unless otherwise specified (600 amp minimum, all copper components), and shall conform to the following requirements:
 1. All switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit breaker type, unless otherwise indicated, and shall contain the equipment indicated and specified. Switchboard shall be complete with pull, service and distribution sections.

2. The required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets all welded together in such a manner that the cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with all assembly holes die stamped or jig drilled and openings for interconnections so placed that any cabinet can be located at any position in the assembly without drilling or cutting holes on the job. Deliver the switchboard to the site in completely assembled sections and provide all required assembly bolts and blanking plates. The front plates and doors shall be die formed steel, of not less than 12 gauge furniture steel, completely removable, secured to the cabinet with oval head machine screws with cup washers, uniformly and symmetrically spaced.
3. Breakers shall be automatic, one-piece molded-case, trip-free, common-trip, quick-make, quick-break, thermal-magnetic type bolted to the bus with handles clearly indicating rating in amps and tripped position. Breakers shall have a single handle with no tie-bar. Voltage, amperage and number of poles shall be as indicated on drawings. Breakers shall have lock-out provisions approved by the State for padlocking and shall have a minimum symmetrical short circuit interrupting rating, as determined by the Utility Company and as indicated on the drawings.
4. The meter panel or plate shall meet all requirements of the respective serving Utility and shall be equipped with the fittings required by the serving Utility.
5. Provide silver plated copper bus bars of the capacity as indicated on the drawings between the current transformer and the main section and the distribution sections; also, the full height of the available breaker space in the distribution portions. Bus bar bracing shall be designed to withstand maximum available short circuit current. Provide service cable lugs as required by the Utility Company. Copper bus bars shall be rated at a minimum of 1000 amps per square inch of cross-sectional area. Heat test rating on the bus bars are not acceptable in lieu of the required cross-sectional area.
6. Provide a nameplate for each component on the switchboard. Plates shall indicate the designation of the service, or feeders controlled and the fuse size. Provide a similar nameplate for meters and transformer compartments.
7. Paint the cabinets, framework and all plates inside and out with one coat of rust resisting metal primer and one coat of grey enamel, baked on, or lacquer sprayed on.
8. Manufacture the boards according to standardized drawings and Specifications, which are available for checking, and prepare Shop Drawings and submit for approval. The switchboard shall meet the requirements of all legally constituted authorities having jurisdiction and the respective serving Utility.
9. For the grounded electrical wye service switchboard, provide ground fault protection for the main device. The ground fault protection shall be listed and approved by U.L. and shall consist of a ground sensor encircling all phase conductors and neutral connected to a solid state ground relay which initiates tripping of the circuit interrupting device. The manufacturer shall provide all necessary testing equipment at the site and perform a certified test on the ground protection system in the presence of the District Inspector, Electrical Engineer, and State of California Inspectors during a scheduled "pre-final" observation visit by the Electrical Engineer. All ground fault settings shall not exceed 10% of the main circuit board rating at .2 seconds, unless otherwise indicated.

B. Building Main Switchboard:

1. Building main switchboard shall be of the floor standing metal clad dead front type. Arrangement and construction shall be as indicated and specified. Design, construction and testing shall comply with all Code requirements and applicable ASA, AIEE and NEMA Standards. Structural elements of cubicles shall consist of standard rolled shapes or formed sheet steel members with a 12 gauge minimum thickness. Construction shall be of the bolted or welded type with sufficient mechanical strength to maintain rigidity under shipping, erection, or short circuit stresses. Cubicles shall be insulated and enclosed with captive bolted P & O Mill prime or cold rolled sheet steel covers. End cubicles shall be provided with blanking plates for future additions. Switchboard shall not exceed 91" in height, including wiring gutters or pull spaces. All steel work shall be sanded, cleaned, rustproofed and primed. Finish coating shall be factory standard. Construction marks or damaged surfaces shall be refinished at the job site to match original finish.
 2. Bus work and connections shall be hard drawn copper bars having a minimum conductivity of 98%. Current density for copper shall not exceed 1,000 amps per square inch for connections. Continuous full load temperature rise shall not exceed Code and NEMA requirements. Bus structure shall be free fitted, and shall have sufficient strength and rigidity to withstand short circuits of the magnitude shown on the drawings, without damage or permanent distortion. Connections shall be silver plated and securely bolted together. Fastening bolts shall be nonmagnetic corrosion resistant plated steel or electrical bronze, secured with constant pressure type locking devices. Insulating supports shall be made of high strength impact resistant, flame retardant material. Connections for incoming and outgoing cables shall be supplied with heavy duty pressure type terminal lugs. Cables and internal wiring shall be supported with suitable bolted cleats. Arrangement of incoming and outgoing feeder cables shall be as shown on the drawings or as required. Neutral bus shall have terminals for all active, spare or inactive circuits.
 3. Current transformer mounting facilities and metering mounting facilities shall be provided in accordance with Utility Company requirements.
 4. Main fusible switch shall be quick-make, quick-break type and shall be equipped with current limiting fuses of the size and capacity indicated on the drawings. Main switch shall have a minimum short circuit interrupting rating of not less than the available symmetrical amperes determined by the Utility Company as indicated on the drawings.
 5. Feeder branch circuit breakers shall be bolt-on molded case type, quick-make, quick-break, minimum 480 volts rated, with thermal magnetic trips of frame size and trip rating indicated on drawings. Feeder breakers shall have a minimum short circuit interrupting rating in symmetrical amperes as indicated on the drawings.
 6. Nameplates shall be furnished for each device. A large nameplate identifying the switchboard, showing service voltage, function and current rating shall be supplied.
 7. Provide a minimum of 1" grout under switchboards.
- C. 120/208 volts Distribution Switchboards:
1. 120/208 volts Distribution Switchboards shall be of the convertible floor-standing metal clad dead front type for three-phase, four-wire service. Arrangement and location, including the number of circuit breakers, active and inactive spares, bussing and other details shall be as shown on the drawings or schedules. Circuit breakers shall be of the bolted-on molded case type, with thermal magnetic trips and shall be rated at 250 volts

with frame sizes, number of poles and trip settings shown on the drawings or schedules. Minimum interrupting capacity shall be as indicated on the drawings.

2. Temperature rise and current-carrying capacity of busses and parts shall be in accordance with NEMA Standards and NEC requirements. Components shall possess sufficient strength and rigidity to safely withstand any stresses imposed by shipping, erection or short circuits. Identification nameplates and cardholders shall be provided in accordance with the paragraph entitled "Identification of Circuits and Equipment." Neutral bar shall have terminals for all active, spare or inactive circuits.
 - 3, Lock-off provisions shall be included for all circuit breakers. Padlocking device shall be permanently secured to the panel deadfront plate.
 4. Provide a minimum of 1" grout under all switchboards.
- D. Multi-pole Circuit Breakers: Multi-pole circuit breakers shall have a common operating handle. Construction shall be in accordance with Paragraph 2.01 B5. Phase sequence and circuit numbering shall be uniform. Temperature rise and current carrying capacity of parts shall be in accordance with NEMA Standards and NEC requirements. Components shall possess sufficient mechanical strength and rigidity to safely withstand any stresses imposed by shipping, erection or short circuits. Lock-off provisions shall be included for all circuit breakers.

2.04 CIRCUIT BREAKER ENCLOSURES:

Circuit breaker enclosures shall be U.L. listed, suitable for use as service entrance equipment. The short circuit current rating of an enclosed circuit breaker shall equal the interrupting rating of the supply components' upstream of the unit.

2.05 PANELBOARDS EQUIPMENT:

All panel boards shall be manufactured by Square D, General Electric or equal, unless otherwise specified by the District.

2.06 MOTOR CONTROLS AND CONTROL DEVICES EQUIPMENT:

A. Disconnect Switches:

1. Switches shall be 480 volts or 600 volts, totally enclosed, externally operated, with quick-make, quick-break operating mechanism, interlocked cover with provisions for locking the cover in the closed position and locking the switch in ON and OFF positions. Switches shall be single throw, unless otherwise indicated or specified.
2. Switch enclosure shall be general purpose NEMA Type 1 for indoor locations, and rain tight NEMA Type 3R for outdoor locations, except where otherwise specified. Switches shall be fusible or non-fusible as indicated on the drawings. Fusible switches shall accept cartridge fuses. Current rating of switches, number of poles, solid neutral facilities, and the current rating of fuses shall be as indicated on the drawings. Switches shall have the proper horsepower rating equal to or greater than the horsepower of the motor controlled. Only the lower horsepower rating of dual rated switches will be accepted as a switch rating.
3. A padlocking device shall lock the operating handle and cover with one padlock in both the ON or OFF positions. Switches shall be heavy-duty type, manufactured by General Electric, Westinghouse or Square D. Furnish one padlock and two keys with each switch. Padlock shall be keyed to Master 611 or M-20.
4. Motors 1/3 HP and less: Switches shall be of the toggle type, quick-make, quick-break, rated 2 HP, 250 volts, AC with the number of poles required, provided with wall plate for flush mounting, or in Code approved surface mounting NEMA enclosures. Switches and enclosures shall be weatherproof NEMA 3R when mounted outdoors.

- B. Motor Starters:
1. Motor starters shall be AC magnetic across line starters, unless otherwise indicated on the drawings.
 2. AC magnetic across the line starters shall have manual reset thermal overload protective devices, including heating elements and, unless otherwise indicated or specified, shall be housed in general purpose enclosures with start-stop-reset device or H.O.A. switch as indicated on drawings, built-in and operable from the front and low voltage protection. The NEMA size, voltage rating, number of poles, and special features shall be as indicated on the drawings. The horsepower rating of each starter shall be equal to or greater than the motor horsepower. Starters for motor circuits rated above 240 volts and which are controlled at locations other than the starter, shall be provided with a control circuit transformer having a 120 volts secondary as required. Combination magnetic starters are acceptable. Three-phase starters shall have three-element protection.
 3. Thermal switch starters shall be tumbler type with plaster ears, binding screws for wiring, standard size composition cups which fully enclose the mechanism, and shall be designed to fit standard outlet boxes. Thermal switches shall be fractional horsepower motor starters with thermal overload protective devices including heating elements and with handle providing ON-OFF-RESET control. The horsepower rating, voltage rating, and number of poles shall be determined from the motor horsepower and the voltage indicated on the drawings. Switches shall be key-operated where so indicated on the drawings. Furnish one key with each key type switch. The horsepower rating of each switch shall be equal to or greater than the motor horsepower.
 4. Relays used for directly controlling motors shall have general purpose enclosures, unless otherwise indicated or specified and shall be horsepower rated. The relay size, voltage rating and number of poles shall be determined from the motor horsepower and voltage indicated on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION:

- A. The service conduits shall terminate at the service point as indicated on the drawings and shall extend underground to the main service terminating pull section as indicated. All bends in the conduits shall be long radius type and all sweeps shall have a radius of not less than ten times the conduit trade size. Underground conduits shall be encased in concrete with a minimum 3" thick cover on all sides with multiple conduits spaced not less than 1 1/2" apart.
- B. The service cable shall be connected to the service terminating pull section by the Utility Company.

3.02 CONDUITS CROSSING PUBLIC DEDICATED PROPERTY:

Where service or other conduits cross any public dedicated property, the Contractor shall make the necessary arrangements to open and close the public property and shall pay all costs in connection with the required licenses, permits, fees and deposits. The conduits shall be installed in a manner required by the authorities having jurisdiction.

3.03 STRUCTURAL CONDITIONS:

- A. Where conduits are to pass through or interfere with any structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other building elements to accommodate the electrical work, all such work shall be done as directed and approved by the Architect or designated District representative.
- B. The placement of conduits in concrete slabs and structural members shall comply with the requirements of the applicable Section of CCR Title 21, Public Works and shall be as approved by the Architect.
- C. Where a concrete encasement for underground conduits abuts a foundation wall or underground structure which the conduits enter, the encasement shall be maintained in position in relation to the structure as indicated on the drawings, or rest on a haunch integral with the wall or structure, or shall extend down to the footing projection, or shall be doweled into the structure. Underground structures shall include pull boxes and buildings.
- D. All cutting and patching of the rough and finish construction work shall be done as required for the installation of the work under this Section. Patching shall be of the same materials, workmanship and finish as, and shall accurately match the surrounding work. The work shall be done under the instruction of the Architect.

3.04 TRANSFORMER INSTALLATION:

- A. Transformer core frame shall be installed level on shock absorbing pads within the enclosure.
- B. Mounting bolts on floor-mounted transformers shall be extended into pads only and shall not be in direct contact with building structural members.
- C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits.

3.05 TRANSFORMER VOLTAGE CHECK:

- A. The Contractor shall set the taps on all transformers (which are a part of this contract) as necessary to provide satisfactory operating voltages with all present loads energized. A check shall be made in the presence of the District Inspector at a panel fed from each transformer and which is the farthest from the transformer. Voltages at the transformers ranging from 118 to 122 volts inclusive, for 120-volt systems and proportionately equivalent for higher voltage systems, are acceptable.
- B. The Contractor shall provide all instruments and accessories required to perform the checks. Volt meters shall be accurate within 1% and shall have scales permitting the voltage readings to be made on the upper half of the scale. Calibration of the meters shall be satisfactory to the District.

3.06 SWITCHBOARD AND PROTECTION DEVICES INSTALLATION:

Torque valves for tightening of wire lugs or any wire/cable connections shall be the minimum as recommended by the manufacturer.

3.07 SWITCHBOARD AND PROTECTION DEVICES PADS AND ANCHORING:

Where free standing equipment is installed, concrete pads shall be provided as described under Division 3, Concrete, and as detailed on the drawings. Where a utility meter is housed in a switchboard, the pad shall extend 3' from the face of the switchboard door or board, whichever is greater. Anchor bolts for free standing equipment shall be designed to meet State Seismic requirements. Equipment shall be anchored to new slab with expansion bolts as indicated on the drawings. All anchor bolts shall be tested to withstand minimum torque as indicated on the drawings.

3.08 SWITCHBOARD AND PROTECTION DEVICES TESTING:

A. All systems of wiring shall be so installed that when completed, the systems will be free from short circuits and from grounds, other than required grounds. The Contractor shall provide all instruments for testing and shall demonstrate in the presence of the District Electrical Inspector that each system of wiring meets the following minimum requirements for insulation resistance;

1. For circuits of No. 12 AWG or smaller - 1,000,000 ohms.
2. For circuits of No. 10 AWG or larger conductors, a resistance shall be based on the following allowable current-carrying capacity of conductors:

25 to 50 amperes inclusive	250,000 ohms
51 to 100 amperes inclusive	100,000 ohms
101 to 200 amperes inclusive	50,000 ohms
201 to 400 amperes inclusive	25,000 ohms
401 to 800 amperes inclusive	12,000 ohms
Over 800 amperes inclusive	5,000 ohms

3. The above values shall be obtained with all switchboards, fuse holders, switches, and over current devices in place and connected and all switches closed.

B. The Contractor shall provide a Meager insulation tester which applies a minimum of 500 volts direct current for the tests when requested by the District Inspector.

3.09 PANELBOARDS INSTALLATION:

A. Fronts shall be flush type, unless otherwise indicated and shall be fastened to the cabinets with 1/4" No. 20, nickel plated oval headed machine screws and cup washers. Sufficient screws shall be installed to prevent buckling or warping of the panel front. Flush type fronts shall be aligned plumb and square and cabinet shall be drilled and tapped for cover screws at the site to accomplish this if necessary.

B. All surfaces of flush mounted panel board cabinets shall be galvanized. The fronts shall be given two coats of metal primer, and a finish coat of baked on gray enamel and shall not be installed on the cabinets until after the finish coats of paint have been applied to the wall and cabinet fronts and they are thoroughly dry. Screws and cup washers shall not be painted.

- C. All surfaces of surface mounted cabinets and fronts shall be given one coat of metal primer and a finish coat of baked on gray enamel.
- D. Panel board cabinets shall be rigidly supported in place independent of the conduits.

3.10 PANELBOARDS, MODIFICATION OF EXISTING SURFACE MOUNTED PANELS:

- A. When an existing flush mounted panel is to be abandoned. Remove existing bussing, breakers and covers. Install new panel with one of the following methods:
 - 1. Provide new weatherproof surface mounted cabinet over existing flush panel cabinet. New cabinet shall be sized to fit over existing panel with hinged padlock able door. Back cover of new cabinet shall be cut to fit the existing panel's opening. Make sure old panel has clean surface for a sufficient ground. All cut edges shall be grounded smooth. Drill edge of new cabinets back cover and existing panel front and secure with ¼ 20 nuts and bolts, lockwashers, new cabinet shall be used as a pull box. See detail E-1.
 - 2. Provide new weatherproof surface mounted panel on wall, new panel shall have breakers per panel schedule. Secure to existing wall next to new surface cabinet. Run between new panel and new cabinet: one 2" C with new feeders to new panel: two 2" c with new wiring as required to connect existing and new branch wiring. See detail E-3.
 - 3. Remove existing panel front, buss assembly, circuit breakers and ground bar, provide a new solid cover with a continuous gasket around parameter to blank off existing enclosure. New cover shall be manufactured of 12 ga. Sheet metal and shall be primer coated for final finish coat by the painting contractor. Attach new solid cover to existing panel enclosure with galv. Tamperproof screws. Contractor shall field verify exact dimensions of existing enclosure. Provide four 2-1/2" conduit nipples between existing panel. Pick up and extend existing feeders and all branch circuits to the new panel and reconnect to matching circuit breakers. Provide power distribution / terminal blocks as required. Bond and ground new panel per N.E.C. article 250.

END OF SECTION

SECTION 312000
EARTHWORK: EXCAVATION, FILLING AND GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY:

- A. This Section includes the following:

1. Excavating soil and other material for surface improvements.
2. Placing fill.
3. Compaction of existing ground and fill.
4. Preparation of subgrade for other improvements.
5. Grading of soil.

- B. RELATED SECTIONS

1. Contract General Conditions and Division 1, General Requirements
2. Section 31 11 00 – Site Clearing
3. Section 31 22 22 – Soil Materials
4. Section 31 23 33 – Trench Excavation and Backfill

1.3 REFERENCES

- A. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- B. Geotechnical Report prepared by Salem Engineering Group, Inc, Project number 1-218-0383, dated by June 1, 2018, and is available for reference only, at the cost of reproduction.

1.4 DEFINITIONS

- A. Utility: Any buried or above ground pipe, conduit, cable, associate device or appurtenances, or substructure pertaining thereto.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Information indicating the source of all import material, the fill material type and where it is to be used and approval of the District's Inspector of Record for incorporation of import material into the Work.

- B. Material Test Reports:
 - 1. Classification of Soils.
 - 2. Compaction Characteristics of Soils.
 - 3. Density and Unit Weight of Soils in Place.
 - 4. Import material must be approved by District's inspector, Geotechnical Engineer and the California Department of Toxic Substances Control (DTSC) prior to being brought on site.

- C. Project Closeout: In accordance with Specification Section PROJECT CLOSEOUT.
 - 1. Drawings indicating the extent and depth of all engineered fill, and overexcavation and recompaction. This information shall be a part of the Project "As-Built" and Project "Record" Documents in accordance with the Specification Section PROJECT DOCUMENTS.

1.6 QUALITY ASSURANCE

- A. Installer:
 - 1. Qualifications:
 - a. Engage an experienced Installer who has successfully completed three (3) projects of similar scope and size to that indicated for this project within the past 5 years.

- B. Regulatory Requirements:
 - 1. In accordance with Specification Section REGULATORY REQUIREMENTS and the following:
 - a. CARB Materials and equipment used for this Project shall comply with the current applicable regulations of the California Air Resources Board [CARB].
 - b. CF City of Fresno, Codes and Ordinances
 - c. EPA Environmental Protection Agency.
 - d. CAL/OSHA Comply with all provisions of the Construction Safety Orders and the General Safety Orders of the California Division of Occupational Safety and Health, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground excavations.
 - e. DTSC Comply with all requirements of the California Department of Toxic Substance Control (DTSC) regarding soil testing for potential contaminants.

- C. Certificates:
 - 1. Installer's certification that all Earthwork installation meets or exceeds the requirements of this specification.

2. Contractor's certification (on Contractor's letterhead paper) that the Earthwork materials and installation meets or exceeds the requirements of this specification.

D. Meetings:

1. Pre-Installation: Schedule prior to the start of work.
 - a. Coordinate the work with other work being performed.
 - b. Identify any potential problems, which may impede planned progress and proper installation of work regarding quality of installation and warranty requirements.
2. Progress: Scheduled by the Contractor during the performance of the work.
 - a. Review for proper installation of work progress.
 - b. Identify any installation problems and acceptable corrective measures.
 - c. Identify any measures to maintain or regain project schedule if necessary.
3. Completion: Scheduled by the Contractor upon proper completion of the work.
 - a. Inspect and identify any problems which may impede issuance of warranties or guaranties.
 - b. Maintain installed work until the Notice of Substantial Completion has been filed.

1.7 COORDINATION

- A. Coordinate work with Owner's personnel.
- B. Provide required notification to the Geotechnical Engineer so that a representative from the Owner's Geotechnical Engineering consultant can be present for all excavation, filling and grading operations to test and observe earthwork construction.
- C. Verify that the location of existing utilities have been indicated at work site by utility authorities, by Owner, and as specified on the Plans.

1.8 EXISTING CONDITIONS

- A. Existing Conditions:
 1. Examine the site and verify conditions with the Drawings and Specifications. Contractor shall familiarize himself with existing site conditions and any changes that have occurred at the site since the preparation of the contract documents, and shall be responsible to account for any such changes in the price bid for this work.
 2. Thoroughly investigate and verify conditions under which the Work is to be performed.
 3. Locate and identify utilities:

- a. Call a Local Utility Locator Service (USA - "Underground Service Alert" – [800] 227-2600) for the task of locating any applicable off-site and on-site utilities in the area where the Project is located.
4. No allowance for Extra Work will be granted resulting from negligence or failure to meet requirements of this Section.
- B. Where subsurface work involves more than the normal depth of excavation required for the removal and/or construction of surface improvements (surface improvements such as concrete flatwork, paving, landscaping, signs, etc.), the Engineer will have made a diligent attempt to indicate on the plans the location of all main and trunk line utility facilities which may affect the Work. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- C. Under similar circumstance, service laterals and appurtenances will have also been shown where information was available as to their location. In many cases, however, the only available information relative to the existing location of said facilities may have been small scale undimensioned plats. The locations of said facilities, therefore, shall be considered approximate only, until exposed by the Contractor.
- D. Determine exact location of existing buried utilities by:
1. Marking on ground or pavement surface the alignment and extent of the facilities and the probable location of existing utilities using construction plans and existing surface features.
 2. Requesting Underground Service Alert (USA) to indicate location of existing buried facilities (phone 1-800-227-2600). Provide USA a minimum of two (2) working days notice of request for locations, and notify Owner of said request concurrently.
 3. Confirm exact location of existing utilities by hand methods of excavation, or by use of vacuum equipment.
- E. At proposed work location, expose by hand methods (or vacuum equipment) all existing utilities along the route of the proposed work prior to using any mechanical equipment. If mechanical equipment is allowed at a particular location, it may only be used after the completion by the Contractor of a successful exhaustive search by hand (or vacuum equipment) methods to locate all existing facilities as indicated on the plans, and/or as indicated on the ground by USA or Owner's personnel.
- F. Provide Field Engineering to record the location of all utilities encountered. Where locational conflicts exist between existing utilities and the planned location of facilities to be constructed under this Contract, submit detailed information to the Engineer for review and direction.
- G. Maintain all existing utility mains and service lines in constant service during construction of the Work.

- H. Where service disruptions are allowed, minimize the length of such disruptions by proper scheduling and diligent pursuit of the work, and coordinate the timing of any such disruptions in advance with the District.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Dust control: Perform work in a manner as to minimize the spread of dust and flying particles. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of other on-site work.
 - 1. All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, or vegetative ground cover.
 - 2. All land clearing, demolition, grubbing, scraping, excavation, land leveling, grading, and cut and fill activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by pre-soaking.
 - 3. When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions or at least six inches of freeboard space from the top of the container shall be maintained.
 - 4. All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at least once every 24 hours when operations are occurring. The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. The use of blower devices is expressly forbidden.
 - 5. Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/ suppressant.
 - a. Contractor shall comply with all requirements of the San Joaquin Valley Air Pollution Control District (SJVAPCD) for construction activity related to this project.
 - b. A Dust Control Plan, as required by the SJVAPCD, may be required for this project. If required, Contractor shall be responsible for preparing said Dust Control Plan, submitting to the SJVAPCD for review and approval, and paying all SJVAPCD review and permitting fees related to the Dust Control Plan.
 - c. If a dust control plan is required, no construction activity related to this project may begin until Contractor has secured an approved Dust Control Plan.
 - d. Contractor shall be solely responsible to implement all requirements of the Dust Control Plan throughout the life of this contract.
 - e. Should fines or fees be levied against the Project for violations of the Dust Control Plan and/or related SJVAPCD regulations, Contractor shall be responsible to pay all said fines or fees and to implement all mitigation measures required by SJVAPCD in order to bring the construction activity into compliance with SJVAPCD regulations. The costs for any such fines or fees shall be included in the lump sum

price bid for work under this contract and no additional payment will be made therefore

- B. Burning: No burning will be allowed on-site.
- C. Rain: Work under this section shall not be started or maintained under threat of rain, unless the work is not affected by the rain.
- D. Do not place fill during weather conditions which will alter moisture content of fill materials sufficiently to make compaction to the specified densities difficult or impossible.
- E. When reference is made to SWPPP (Storm Water Pollution Prevention Plan), if any within this Project Manual, then comply with all environmental protection requirements included therein.
- F. In accordance with EPA, CARB and CF.
- G. Protection:
 - 1. Protect cut and fill areas to prevent water running into excavation. Maintain areas free of water. Remove seeping water immediately by pumps. Provide dewatering as necessary.
 - 2. Protect cut slopes from erosion due to precipitation and other sources of runoff.
 - 3. Protect utilities to remain within the construction area and special construction. If utility lines are uncovered (water, electric, sewer, etc.) not shown on the drawings during excavation of site, notify the Architect promptly for its review and action.
 - 4. Do not permit access to undeveloped portions of the site, nor to areas that are outside of the limits of grading.

1.10 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of GENERAL CONDITIONS and DIVISION 1, GENERAL REQUIREMENTS.
- B. Accurately record actual locations of utilities encountered including depth and horizontal location, as measured from permanent site features.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill in Turf or Other Planting Areas: Type S2 or S3 per Division 31 Specification Section SOIL MATERIALS.
- B. Fill in Non-planting Areas: Type S1, S2 or S4 per Division 31 Specification Section SOIL MATERIALS.
- C. Imported material: Type S3, S4 or S5 per Division 31 Specification Section SOIL MATERIALS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.

3.2 PREPARATION

A. Layout of Work:

1. Contractor shall be responsible for all lines and grades. Layout shall be provided by a California registered Land Surveyor or Civil Engineer, at Contractor's expense.
2. Check all bench marks, monuments and property lines and verify locations.
3. Locate and maintain all grade stakes.
4. Monuments moved or displaced during grading operation are to be replaced by a California Registered Civil Engineer or Surveyor, at Contractor's expense.

- B. Locate, identify, and protect existing above and below grade utilities from damage.

- C. Protect plant life, lawns, trees, shrubs, and other features not authorized for removal.

- D. Protect existing structures, fences, curbs, sidewalks, paving and other improvements to remain from damage from excavation equipment and vehicular traffic. E. Employ equipment and methods appropriate to the work site.

- F. Protect excavated areas from drainage inflow, and provide for drainage of all excavated areas.

- G. Comply with all provisions of the Construction Safety Orders and General Safety Orders of the California Division of Industrial Safety, as well as all other applicable regulations as they pertain to the protection of workers from the hazard of caving ground in excavations.

3.3 SITE STRIPPING:

- A. Reference is made to Division 31 Specification Section SITE CLEARING.

- B. Within the areas of planned surface improvements and structures, the near surface soils containing vegetation, roots, organics, or other objectionable material must be stripped and removed from the site. Upon approval of the Geotechnical Engineer, suitable materials stripped from the site may stockpiled and incorporated into the finish fill for planting areas.

- C. All areas to receive surface improvements shall be stripped to remove turf, shrubs, trees and other vegetation, along with associated root systems, concrete, wood, metal, rubbish and other unsuitable debris, and any loose, saturated or unconsolidated soil material. Minimum stripping

depth is expected to be 2-inches below existing site grades. Stripping shall continue to the depth required to expose acceptable basement soils that are free from deleterious which are not suitable for Engineered Fill, as required by the Geotechnical Engineer.

3.4 EXCAVATION

- A. Following clearing and stripping operations, excavate planned construction areas as specified in this Section.
- B. Provide additional excavation as required to conform to the lines, grades and cross-sections shown on the plans.
- C. When excavating through tree roots, perform work by hand and cut roots, where authorized, with a saw. Remove all roots $\frac{1}{4}$ " in diameter and greater.
- D. Remove excess soil not to be used as fill in the Work from the site. Unless requested by Owner to be deposited at a site designated by Owner on the property, obtain a disposal site and legally dispose of said excess material, all at no additional cost to the Owner.
- E. Areas disturbed by demolition must be excavated to expose undisturbed soils.
- F. Excavated soils free of deleterious substances (organic matter, demolition debris, tree roots, etc.) and with less than 3% organic content by weight may be returned to the excavations as Engineered Fill.

3.5 FILLING AND COMPACTING

- A. Once clearing, stripping and over-excavation operations are complete, scarify the surface to receive fill material or improvements to a depth of 8-inches, moisture condition to at least 2% above optimum moisture content, and compact to a minimum of 92% of maximum dry density based on ASTM Test Method 1557.
- B. Place and compact soil to finish subgrade of improvements to be placed thereon, or to finished surface grade where no improvements are to be placed thereon. C. All fill required shall be placed as Engineered Fill.
- D. Imported fill shall be approved by the Geotechnical Engineer prior to placement
- E. On-site soils are suitable for re-use as Engineered Fill, providing they are cleansed of excessive organics (less than 3 percent by weight, ASTM D2974), debris, and fragments larger than three (3) inches in maximum dimension and meet the requirements of soil Type S4, Division 31 Specification Section SOIL MATERIALS.

- F. Engineered Fill shall be moisture conditioned to within 2% of optimum moisture, placed in uncompacted layers not exceeding eight (8) inches in thickness, and compacted as specified, based on ASTM Test Method D1557.
 - 1. Non-vegetative surface improvement areas (structures, pavement and site concrete improvements) - To a minimum of 92% of maximum dry density.
 - 2. Vegetative surface improvement areas (turf and planters) - Below top twelve (12) inches - to a minimum of 90% of maximum dry density. Top twelve (12) inches - 85% of maximum dry density.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. Additional lifts shall not be placed if the previous lift did not meet the required dry density, or if soil conditions are not stable.
- I. Conform fill to the lines, grades and cross-sections shown on the plans.
- J. Fill materials to conform to Division 31 Specification Section SOIL MATERIALS.
- K. Provide, at no additional cost to Owner, imported soil material conforming to the requirements of Division 31 Specification Section SOIL MATERIALS, as needed to attain finished grades of Work.
- L. Utilize equipment which will not disturb or damage existing utilities and other improvements.

3.6 PREPARATION OF SUBGRADE FOR SURFACE IMPROVEMENTS

- A. Where concrete, asphalt-concrete, aggregate base, or other non-vegetative surface improvements, or a layer of said surface improvements, are to be constructed on the soil surface, prepare the subgrade for said improvements in accordance with this section.
- B. Scarify the soil as specified and remove and dispose of (off the project site) all rocks, hardpan chunks or otherwise unsuitable material over 2 ½ inches in size.
- C. Thoroughly moisture condition and compact as described above.
- D. Prior to commencing construction of surface improvements, pass a test roller of size and weight as approved by the Owner over the subgrade to establish the extent of soft or spongy areas requiring repairs.
- E. Conform finished subgrade surface to the lines, grades and cross-sections shown on the plans.

3.7 FINE GRADING

- A. Fine grade all finished surfaces to the lines, grades and cross-sections shown on the plans, and to blend to hard surface improvements.

- B. Rake and smooth all finished surfaces not to receive hard surface improvements.
- C. Use suitable stockpiled or imported topsoil for the top 12-inches of areas to receive landscape improvements.
- D. Import topsoil meeting the requirements of Division 31 Specification Section SOIL MATERIALS, as required to complete finish grading.
- E. Topsoil may not be used in areas requiring Engineered Fill.

3.8 TOLERANCES

- A. Top surface of Subgrade for Non-Vegetative Surface Improvements or Layers thereof: Plus or minus 0.02 foot from planned elevation.
- B. Top surface of Subgrade for Vegetative Surface Improvements or for Bare Ground - Plus or minus 0.05 foot of planned elevation, or as required for finish surface to match adjacent improvements or ground.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of GENERAL CONDITIONS and/or DIVISION 1, GENERAL REQUIREMENTS.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557.
- C. If tests indicate work does not meet specified requirements, recompact, or remove and replace, and retest.
- D. All retesting required as a result of failure of initial test will be performed by Owner's testing agency, at the expense of the Contractor.

3.10 PROTECTION

- A. Protect graded areas from traffic, freezing, erosion, and all other sources of damage. Keep free of debris and trash.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed work becomes eroded, rutted, settled, or where it is damaged by subsequent construction operations or weather.
- C. Where settlement occurs prior to acceptance of the work, remove and replace surface improvements, excavate, replace, and re-compact in accordance with these specifications, and restore the surface improvements.

3.11 CLEANING

- A. Remove all surplus or unsatisfactory soil material, trash, and debris, and legally dispose of off of the Owner's property.

END OF SECTION

