



MECHANICAL AND ELECTRICAL IMPROVEMENTS TO A UTILITY BUILDING FOR THE LAWRENCE COUNTY BOARD OF EDUCATION MOULTON, ALABAMA

Project No: 17-189 Date: 09.01.17



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INDEX

MECHANICAL AND ELECTRICAL IMPROVEMENTS TO A UTILITY BUILDING FOR THE LAWRENCE COUNTY BOARD OF EDUCATION MOULTON, ALABAMA

PROJECT NO. 17-189

ALL WORK AND MATERIALS SHALL BE PURCHASED AND INSTALLED BY THE LAWRENCE COUNTY BOARD OF EDUCATION AND THEIR REPRESENTATIVES.

BIDDING REQUIREMENTS - NA

CONTRACT FORMS - NA

<u>GENERAL</u> <u>CONDITIONS</u> - <u>NA</u>

TECHNICAL SPECIFICATIONS

000000	
02070	Selective Demolition
03310	Concrete Work
07900	Joint Sealers
08100	Steel Doors and Frames
08700	Finish Hardware
09900	Painting
10520	Fire Extinguishers and Accessories
15010	General Mechanical Provisions
15700	Heating, Ventilating and Air Conditioning
16100	Electrical

SECTION 02070 - SELECTIVE DEMOLITION

<u>PART 1 - GENERAL</u>

DESCRIPTION OF WORK

<u>Extent</u> of demolition work is shown on drawings as well as all items necessary to complete new work indicated on plans.

<u>Schedule of Demolition Work:</u> Demolition includes but is not limited to the following:

1. All other items indicated required to be demolished to complete new work.

JOB CONDITIONS

Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable.

Explosives: Use of explosives will not be permitted.

<u>Traffic</u>: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

<u>Protections</u>: Ensure safe passage of persons (night or day) around area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons.

<u>Damages</u>: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.

<u>Utility Services</u>: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

 Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities. 2. All electrical work to be removed, relocated or reconnected shall be preformed by a licensed Electrical Contractor in accordance with the NEC and any applicable local codes and ordinances.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

DEMOLITION

DISPOSAL OF DEMOLISHED MATERIALS

<u>General</u>: Remove from site debris, rubbish and other materials resulting from demolition operations. Burning of removed materials from demolished structures will not be permitted on site.

<u>Removal</u>: Transport materials removed from demolished structures and legally dispose of off site, in area approved by all local authorities and ADEM.

END OF SECTION 02070

SECTION 03310 - CONCRETE WORK

PART <u>1 -</u> GENERAL

DESCRIPTION OF WORK:

Extent of concrete work is shown on drawings.

QUALITY ASSURANCE:

<u>Codes and Standards</u>: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

- 1. ACL 301 "Specifications for Structural Concrete for Buildings".
- 2. ACI 318 "Building Code Requirements for Reinforced Concrete"
- 3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

SUBMITTALS:

<u>Product Data</u>: Submit data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joints systems, curing compounds, dry-shake finish materials and others as requested by Architect.

<u>Shop Drawings Reinforcements</u>: Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement.

<u>Material</u> <u>Certificates</u>: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

FORM MATERIALS:

<u>Forms for Unexposed Finish Concrete</u>: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

<u>Form</u> <u>Coatings</u>: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

REINFORCING MATERIALS:

Reinforcing Bars: ASTM A 615, Grade 60, deformed, unless otherwise noted.

- 1. <u>Steel Wire</u>: ASTM A 82, plain, cold-drawn, steel.
- 2. <u>Welded Wire Fabric</u>: ASTM A 185, welded steel wire fabric.

<u>Supports</u> for <u>Reinforcement</u>: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications, unless otherwise acceptable.

CONCRETE MATERIALS:

Portland Cement: ASTM C 150, Type 1, unless otherwise acceptable to Architect.

Use one brand of cement throughout project, unless otherwise acceptable to Architect.

<u>Normal Weight Aggregate</u>: ASTM C 33, and as herein specified. Provide aggregate from a single source for all concrete.

Do not use fine or coarse aggregates containing spalling-causing deleterious substances.

<u>Water</u>: Drinkable.

Air-Entraining Admixture: ASTM C 260.

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

"Air-Mix", Evclid Chemical Co. "Sika-Air", Sika Corp. "Darex AEA", W. R. Grace

Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

<u>Water-Reducing</u>, <u>Non-Chloride</u> <u>Accelerator</u> <u>Admixture</u>: ASTM C 494, Type E, and containing not more than 0.1% chloride ions.

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

"Accelguard 80"; Euclid Chemical Company "Pozzolith High Gally"; Master Builders

Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

<u>Water-Reducing</u>, <u>Retarding</u> <u>Admixture</u>: ASTM C 494, Type D, and contain not more than 0.1% chloride ions.

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

"Edoco 20006"; Edoco Technical Products "Pozzolith 300-R"; Master Builders "Eucon Retarder 75"; Euclid Chemical Company "Daratard"; W. R. Grace "Plastiment"; Sika Chemical Company

Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

<u>Certification</u>: Provide admixture manufacturer's written certification that chloride ion content complies with specified requirements.

Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

RELATED MATERIALS:

<u>Liquid Membrane Forming Curing Compound</u>: Liquid type membrane forming curing compound complying with ASTM C 309, Type 1-D, Class A unless other type acceptable to Architect. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

"Masterseal"; Master Builders "Ecocure"; Euclid Chemical Company "Clear Seal"; A. C. Horn "Kure-N-Seal"; Sonneborn-Contech Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type.

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

"Welcrete"; Larsen Products "EucoWeld"; Euclid Chemical Company "Hornweld"; A. C. Horn "Sonocrete"; Sonneborn-Contech "Acrylic Bondcrete"; The Burke Company

Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

<u>Epoxy</u> <u>Adhesive</u>: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

<u>Manufacturers</u>: The following manufacturers' products have been used establish minimum standards for materials, workmanship and function:

"Epoxtite"; A. C. Horn "Sikadur Hi-Mod"; Sika Chemical Corporation "Euco Epoxy 463 or 615"; Euclid Chemical Company "Patch and Bond Epoxy"; The Burke Company "Sure-Poxy"; Kaufman Products, Inc.

Equal products of other manufacturers may be used in the work, provide such products have been approved, by the Architect, not less than five (5) days prior to scheduled bid opening.

PROPORTIONING AND DESIGN OF MIXES:

Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.

Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

Design mixes to provide normal weight concrete as indicated on drawings and schedules.

<u>Adjustment to Concrete Mixes</u>: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

Admixtures:

Use water-reducing admixture in all concrete for ease of placement and workability.

Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.

Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6% with a tolerance of plus-or-minus 1-1/2%.

<u>Slump</u> <u>Limits</u>: Proportion and design mixes to result in concrete slump at point of placement as follows:

- 1. Reinforced foundation systems: 2" to 5".
- 2. Other concrete: 3" to 5".

CONCRETE MIXES:

<u>Ready-Mix</u> <u>Concrete</u>: Comply with requirements of ASTM C 94, and as herein specified.

During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When air temperature is between 85 degrees F and 90 degrees, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

FORMS:

Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.

Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

Construct forms to sizes, shapes, lines and dimensions shown and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, off-sets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses and the like, to prevent swelling and for easy removal.

Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set time to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

<u>Form Ties</u>: Factory-fabricated, adjustable-length, removable, or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

Unless otherwise indicated, provide ties so portion remaining within concrete after removal is 1" inside concrete and will not leave holes larger than 1" diameter in concrete surface.

<u>Provisions for Other Trades</u>: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

<u>Cleaning and Tightening</u>: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

PLACING REINFORCEMENT:

Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports, and as herein specified.

Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

Accurately position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers as required.

Place reinforcement to obtain at least minimum coverage for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

INSTALLATION OF EMBEDDED ITEMS:

<u>General</u>: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

<u>Edge Forms and Screed Strips for Slabs</u>: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

PREPARATION OF FORM SURFACES:

Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.

Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

CONCRETE PLACEMENT:

<u>Replacement Inspection</u>: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

<u>General</u>: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", and as herein specified.

Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams of planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

<u>Placing Concrete in Forms</u>: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

<u>Cold Weather Placing</u>: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

When air temperature has fallen to or is expected to fall below 40 degrees F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F. and not more than 80 degrees F at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not place concrete when air temperature has fallen to or is expected to fall below $35^{\circ}F$.

Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

<u>Hot</u> <u>Weather</u> <u>Placing</u>: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACE 305 and as herein specified.

Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

FINISH OF FORMED SURFACES:

<u>Rough Form Finish</u>: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

<u>Related</u> <u>Unformed</u> <u>Surfaces</u>: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

MONOLITHIC SLAB FINISHES:

<u>Non-Slip</u> <u>Broom</u> <u>Finish</u>: Apply non-slip broom finish to exterior concrete platforms, steps and ramps and elsewhere as indicated.

Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

CONCRETE CURING AND PROTECTION:

<u>General</u>: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days.

Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

<u>Curing Methods</u>: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

Provide moisture curing by one of the following methods or by a combination of the following methods:

- 1. Keep concrete surface continuously wet by covering with water.
- 2. Continuous water-fog spray.
- 3. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

Provide moisture-cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Provide curing and sealing compound to interior slabs with resilient flooring, carpet over cushion, or left exposed; and to exterior slabs, walks, and curbs as follows:

1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

Do not use membrane curing compounds on surface which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting and other coatings and finish materials, unless otherwise acceptable to Architect.

<u>Curing Formed Surfaces</u>: Cure formed concrete surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

<u>Curing Unformed Surfaces</u>: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

<u>Sealer and Dustproofer</u>: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

REMOVAL OF FORMS:

Formwork not supporting weight of concrete, such as sides of walls, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for twenty-four (24) hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided cutting and protection operations are maintained.

Formwork supporting weight of concrete, may not be removed in less than fourteen (14) days and until concrete has attained design minimum compressive strength of in place concrete by testing field-cured specimens representative of concrete location in members.

Form facing material may be removed four (4) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

RE-USE OF FORMS:

Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

MISCELLANEOUS CONCRETE ITEMS:

<u>Filling-In</u>: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

<u>Curbs</u>: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

<u>Equipment Bases and Foundations</u>: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

<u>Reinforced</u> <u>Masonry</u>: Provide concrete grout for reinforced masonry, masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

CONCRETE SURFACE REPAIRS:

<u>Patching Defective Areas</u>: Repair and patch defective areas with cement mortar immediately after removal of forms when acceptable to Architect.

Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

For exposed to view surfaces, blend white portland cement and standard portland cement so that when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

<u>Repair of Formed Surfaces</u>: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

<u>Repair of Unformed Surfaces</u>: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets and other objectionable conditions.

Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

Correct low areas in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Architect.

Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and exposed reinforcing steel with at least 3/4" clearance all around.

Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than seventy-two (72) hours.

Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

Repair methods not specified above may be used, subject to acceptance of Architect.

QUALITY CONTROL TESTING DURING CONSTRUCTION:

<u>Sampling</u> <u>Fresh</u> <u>Concrete</u>: ASTM C 172, except as modified for slump to comply with ASTM C 94.

- 1. <u>Slump</u>: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
- <u>Concrete Temperature</u>: Test hourly when air temperature is 40 degrees
 F. and below, and when 80 degrees F. and above; and each time a set of compression test specimens made.
- 3. <u>Compression Test Specimen</u>: ASTM C 31; one set of four (4) standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

<u>Compressive Strength Tests</u>: ASTM C 39; one set for each day's pour plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at seven (7) days, two specimen tested at twenty-eight (28) days, and one specimen retained in reserve for later testing if required. Minimum compressive strength of concrete shall be 3,000 psi at 28 days unless otherwise indicated.

When frequency of testing will provide less than five (5) strength tests for a given class of concrete, conduct testing from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.

When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived by Architect if, in his judgment, adequate evidence of satisfactory strength is provided.

When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

Test results shall be reported in writing to Architect and Contractor within twenty-four (24) hours that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at twenty-eight (28) days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

<u>Nondestructive</u> <u>Testing</u>: Impact hammer, sonoscope, or other non- destructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

END OF SECTION 03310

SECTION 07900 - JOINT SEALERS

PART 1 - GENERAL

DESCRIPTION OF WORK:

<u>The</u> <u>extent</u> of each form and type of joint sealer is indicated on drawings and by provisions of this section.

The <u>applications</u> for joint sealers as work of this section include the following:

- 1. Joints (Exterior).
- 2. Flashing Joints.

<u>General Performance</u>: Except as otherwise indicated, joint sealers are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, within recognized limitations of wear and aging as indicted for each application. Failures of installed sealers to comply with this requirement will be recognized as failures of materials and workmanship.

SUBMITTALS:

<u>Product Data</u>: Submit manufacturer's product specifications, handling/installation/curing instructions, and performance tested data sheets for each elastomeric product required.

JOB CONDITIONS:

<u>Weather Conditions</u>: Do not proceed with installation of liquid sealants under unfavorable weather conditions. Install elastomeric sealants when temperature by manufacturer for installation.

PART 2 – PRODUCTS

ACCEPTABLE MANUFACTURERS:

<u>General</u>: manufacturers listed in this article include those known to produce the indicated category of prime joint sealant material, either as a nominally pure generic product or as an equivalent-performance modification thereof or proprietary product.

<u>Manufacturers</u>: The following manufacturer's products have been used to establish minimum standards for materials, workmanship and function:

1. <u>Polyurethane Sealants:</u> Bostik. Master Builders. Pecora Corp. Sonneborn Building Products. Tremco, Inc.

2. <u>Butyl Sealants:</u> Bostik. TEC Incorporated. Tremco, Inc.

Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than five (5) days prior to scheduled bid opening.

MATERIALS:

NOTE: The use of silicone sealants shall not be used at any exterior conditions.

<u>General Purpose Exterior Sealant:</u> Polyurethane; ASTM C 920, Grade NS, Class 25, Uses M, G, and A; single component. (Silicone sealant shall not be used at exterior conditions).

- 1. <u>Color:</u> Standard colors matching finished surfaces.
- 2. <u>Applications</u>: Use for:
 - a. Control, expansion, and soft joints in masonry, stone or concrete.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.

<u>Exterior Metal Lap Joint Sealant:</u> Butyl or polyisobutylene, nondrying, nonskinning, noncuring.

- 1. <u>Applications:</u> Use for:
 - a. Concealed sealant bead in sheet metal work.

<u>Bituminous and Fiber Joint Filler</u> (BtmF-JF) provide resilient and non-extruding type premolded bituminous-impregnated fiberboard units complying with ASTM D 1751; FS HH-F-341, Type I; or AASHTO M213.

Miscellaneous Materials:

<u>Joint Primer/Sealer</u>: Provide type of joint primer/sealer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

<u>Bond</u> <u>Breaker Tape (BB-Tp)</u>: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.

Provide self-adhesive tape where applicable.

<u>Sealant Backer Rod (S-BR)</u>: provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.

PART 3 - EXECUTION

INSPECTION:

<u>Installer must examine</u> substrate, (joint surfaces) and conditions under which joint sealer work is to be performed and must notify Prime Contractor of unsatisfactory conditions.

JOINT PREPARATION:

<u>Clean joint surfaces</u> immediately before installation of gaskets, sealants or caulking compounds. Remove dirt, insecure coatings, moisture and other substrate which could interfere with seal of gasket or bond of sealant of caulking compound. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

<u>Prime or seal joint surfaces</u> where indicated, and where recommended by sealant manufacturer. Confine primer/sealer to areas of sealant bond; do not allow spillage or migration onto adjoining surfaces.

INSTALLATION:

<u>Comply with manufacturer's printed instructions</u> except where more stringent requirements are shown on specified, and except where manufacturer's technical representative directs otherwise.

<u>Set joint filler units at depth</u> or position in joint as indicated to coordinate with other work, including installation of bond breakers, backer rods and sealant. Do not leave voids or gaps between ends of joint filler units.

<u>Install sealant backer rod</u> for liquid-applied sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for application indicated.

Install bond breaker tape where indicated and where required by manufacturer's recommendations to ensure that liquid-applied sealants will perform as intended.

<u>Employ only proven installation techniques</u>, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

<u>Install sealant to depths</u> as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of beads;

<u>For normal moving joints</u> sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.

<u>Spillage</u>: Do not allow sealants or compounds to overflow from confines of joints, or to spill onto adjoining work, or to migrate into voids of exposed finishes. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

<u>Recess</u> <u>exposed</u> <u>edges</u> of gaskets and exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

<u>Bond ends of gaskets</u> together with adhesive of "weld" by other means as recommended by manufacturer to ensure continuous watertight and airtight performance. Miter-cut and bond ends at corners unless molded corner units are provided.

CURE AND PROTECTION:

<u>Cure sealants</u> and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise Prime Contractor of procedures required for cure and protection of joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of substantial completion. Cure and protect sealants in manner which will minimize increases in modulus of elasticity and other accelerated aging effects. Replace or restore sealants which are damaged or deteriorated during construction period.

END OF SECTION 07900

SECTION 08100 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

DESCRIPTION OF WORK:

Extent of standard steel doors and frames is shown and scheduled on drawings.

Builder's hardware is specified elsewhere in Division 8.

QUALITY ASSURANCE:

<u>Provide</u> <u>doors</u> <u>and</u> <u>frames</u> complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

<u>Fire-Rated Assemblies</u>: At fire-rated walls and partitions, provide fire-rated doors and frames investigated and tested as fire door assemblies, complete with type of hardware to be used. Identify each fire rated component of the assembly with recognized testing laboratory labels, indicating applicable fire rating. Provide assemblies to comply with NFPA Standard No. 80, and as herein specified. Whether indicated on Plans or not, all doors and frames in rated walls shall be rated with appropriate ratings.

SUBMITTALS:

<u>Product</u> <u>Data</u>: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.

<u>Shop</u> <u>Drawings</u>: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

DELIVERY, STORAGE AND HANDLING:

<u>Deliver</u> hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.

<u>Inspect</u> hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

<u>Store</u> doors and frames at building site under cover. Place units on wood sills at least 4" high, or otherwise store on floors in manner that will prevent rust and damage. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4" spaces between stacked doors to promote air circulation.

PART 2 – PRODUCTS

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

Amweld Building Products Div. Ceco Corp. Curries Mfg. Inc. Fenestra. Bymoco Mesker Steelcraft

Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than five (5) days prior to scheduled bid opening.

MATERIALS:

<u>Hot-Rolled</u> <u>Steel</u> <u>Sheets</u> <u>and</u> <u>Strip</u>: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

<u>Cold-Rolled</u> <u>Steel</u> <u>Sheets</u>: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

Supports and Anchors: Fabricate of not less than 18 gage galvanized sheet steel.

<u>Inserts</u>, <u>Bolts</u> and <u>Fasteners</u>: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

Shop Applied Paint:

<u>Primer</u>: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

FABRICATION, GENERAL:

<u>Fabricate steel door</u> and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site.

<u>Fabricate</u> <u>exposed</u> <u>faces</u> of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

<u>Fabricate</u> <u>frames</u>, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

<u>Exposed</u> Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

Finish Hardware Preparation:

Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.

<u>Reinforce</u> <u>doors</u> <u>and</u> <u>frames</u> to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

<u>Locate</u> <u>finish</u> <u>hardware</u> as shown on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

Shop Painting:

<u>Clean</u>, <u>treat</u>, <u>and</u> <u>paint</u> exposed surfaces of steel door and frame units, including galvanized surfaces.

<u>Clean</u> <u>steel</u> <u>surfaces</u> of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

<u>Apply shop coat</u> of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

STANDARD STEEL DOORS:

<u>Provide metal doors</u> of types and styles indicated on drawings or schedules. Minimum thickness 18 gauge for interior and 16 gauge for exterior doors. Doors shall be hot-dipped galvanized steel.

STANDARD STEEL FRAMES:

<u>Provide metal frames</u> for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Minimum thickness I6 gauge for interior and 14 gauge for exterior frames. Frames shall be hot-dipped galvanized steel.

1. <u>Fabricate frames with mitered and fully welded corners.</u>

<u>Door</u> <u>Silencers</u>: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.

PART <u>3 – EXECUTION</u>

INSPECTION:

<u>Installer must examine</u> substrate and conditions under which steel doors and frames are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION:

<u>General</u>: Install standard steel doors, frames, and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

Placing Frames:

Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

Except for frames located at in-place concrete or masonry and at drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Install foot brace at bottom of all metal frames until installation of door. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

Metal frames at all interior wall conditions shall be inset $\frac{1}{4}$ " from edge of wall to allow for caulk bead, see detail on drawings.

In plaster or masonry walls constructed with antifreeze additives, protect inside (concealed) faces of door frames using fibered asphalt emulsion coating. Apply approximately 1/8" thick over shop primer and allow to thoroughly dry before handling.

- 1. <u>In masonry construction</u>, locate 3 wall anchors per jamb at hinge and strike levels. Building-in of anchors and grouting of frames is specified in Division 4.
- 2. <u>At in-place concrete or masonry</u> construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.
- 3. <u>Install fire-rated frames</u> in accordance with NFPA Std. No. 80.

Door Installation:

Fit hollow metal doors accurately in frames, within clearances specified below:

- 1. 1/8" at jambs and heads.
- 2. 1/16" per leaf at meeting stiles for pairs of doors.
- 3. For fire-rated doors, provide clearances complying with NFPA80.

ADJUST AND CLEAN:

<u>Prime Coat</u> <u>Touch-up</u>: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

<u>Protection</u> <u>Removal</u>: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

<u>Final Adjustments</u>: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08100

SECTION 08700 - FINISH HARDWARE

PART <u>1</u> – <u>GENERAL</u>

SECTION INCLUDES

- 1. All items known commercially as Finish or Door Hardware.
- 2. Thresholds and Weatherstripping/Door Seals.

RELATED SECTIONS

1. Section 08100 – Steel Doors and Frames.

REFERENCES

- 1. BHMA (Builders Hardware Manufacturers Association) A156 series.
- 2. DHI (Door and Hardware Institute) A115 series.
- 3. SDI 107 84 Hardware on Steel Doors (Reinforcement Application.)
- 4. SDI 109 88 Hardware for Standard Steel Doors & Frames.
- 5. NFPA 80 Fire Doors and Windows.
- 6. NFPA 101-2000 Life Safety Code.
- 7. ADA Americans with Disabilities Act.

SUBMITTALS

<u>Product</u> <u>Data</u> – Submit two (2) copies of manufacturer's catalog sheets describing each item of hardware to be supplied.

<u>Schedules</u> – Submit six (6) copies of hardware schedules for Architect's approval. Schedules are to include quantity, type, location, finish and manufacturer of each item of hardware for each opening. Schedule may be horizontal or vertical format. No material is to be ordered until the submittal is approved. After approval, no substitutions will be allowed without the written approval of the Architect.

<u>Samples</u> – If requested by the Architect, submit a sample of each hardware item in the design and finish to be used on the project. Samples may be used on the project provided they are undamaged during the submittal process.

<u>Templates</u> – Furnish template information to the General Contractor for use by other trades in fabricating related materials.

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17-189

<u>Project Closeout</u> – On completion of the project, furnish one (1) copy of the "as furnished" hardware schedule along with one (1) copy each of the keying schedule, manufacturer's maintenance instructions and any special tools which may be required to maintain or adjust the hardware. In addition, furnish copies of all manufacturer's warranties for the owner's records.

QUALITY ASSURANCE

Manufacturers and products which are acceptable for use on this project are listed in Part 2 of this specification. Substitutions from the listed manufacturers and products without prior, written approval of the Architect are not permitted.

The hardware supplier shall be a firm specializing in finish hardware. The firm shall have been engaged in this business for a period of not less than five (5) years and shall have in its employ a full time, certified Architectural Hardware Consultant (AHC) or person of equivalent experience. This person shall be available to the Architect at reasonable times for consultation regarding this project. This supplier shall be a direct, factory authorized distributor for the manufacturer of the materials being furnished.

The hardware manufacturer shall be a recognized firm regularly engaged in the manufacture and sale of finished hardware items.

If required, the hardware supplier shall furnish certification and documentation that his materials meet all physical and environmental requirements of the project.

As near as possible, obtain each type of hardware (hinges, locks, closers, etc.) from a single manufacturer.

Provide hardware for fire rated openings that complies with the requirements of NFPA 80 and authorities having jurisdiction. Provide only items of door hardware that have been tested and listed by UL, FM, Warnock-Hersey or other testing organizations acceptable to the authorities having jurisdiction.

All hardware shall meet the requirements set forth in the Americans with Disabilities Act (ADA) and state and local handicapped codes.

DELIVERY, STORAGE AND PROTECTION

Package each item individually. Label and clearly identify each package with item nomenclature and door opening. Correlate all making and opening numbers to match the hardware schedule.

The General Contractor is to provide a secure, locked storage area for all items delivered to the jobsite.

17-189	FINISH HARDWARE	08700-2

The General Contractor shall inventory all items delivered to the jobsite within fortyeight hours and advise the supplier immediately of any shortages.

PROJECT CONDITIONS

The General Contractor will coordinate the work between this supplier and other related sections such as hollow metal and wood door suppliers to insure proper manufacturer and fabrication of doors to receive the approved hardware.

WARRANTY

All hardware items are to be warranted for a period of one (1) year from date of substantial project completion. Door closers are to be warranted for ten (10) years.

Warranty is to cover failure due to manufacturing defects or material failure only. It shall not cover abuse, vandalism, improper installation or maintenance. Defective materials are to be replaced at no cost to the owner.

PART 2 - PRODUCTS

MANUFACTURERS

Acceptable products and their manufacturers are listed below. Specific information regarding functions, sizes, mounting and types is found in the hardware sets at the end of the section.

<u>Hinges</u> Hager McKinney Stanley

<u>Exit Devices</u> Von Duprin 99 Series Precision Apex Sargent 8000 Series

<u>Locks and Latches</u> Best 45H Series – 14J Design Schlage L9000L Series – 17L Design Sargent 8200 Series – LW1P Design <u>Closers</u> Sargent 281 Series LCN 4000 Series Ryobi D4550 Series

<u>Overhead Stops and Holders</u> Glynn Johnson ABH Dorma

<u>Push/Pulls/Kickplates</u> Rockwood Hager Ives

<u>Stops and Miscellaneous Items</u> Rockwood Hager Ives

<u>Thresholds</u> and <u>Weatherstripping</u> Pemko National Guard Reese

<u>Substitutions</u> – Substitutions from the listed manufacturers and products without prior approval of the architect are not permitted.

MATERIALS AND FABRICATION

<u>Base</u> <u>Metals</u> – Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.

<u>Fasteners</u> – Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Furnish exposed (exposed under any condition) screws to match hardware finish or if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt heads or nuts are exposed on opposite face unless their use is the only means of adequately securing the hardware or where required on labeled doors. In no case are thru-bolts to be used as a substitute for proper reinforcement of doors or frames.

FINISHES

Finishes for all items are as listed in the hardware schedule at the end of this section.

Finish designations are as listed in ANSI/BHMA A156.18 "American Standards for Materials and Finishes: and are the industry recognized standard commercial finishes.

<u>KEYING</u>

All locks and cylinders to be keyed to Owners existing system. Meet with the owner to determine exact requirements. Key alike in sets or differently as directed by owner. Furnish six (6) masterkeys and three (3) keys per lock. Furnish a complete keying schedule and bitting list for the owner's records.

Furnish a key control system including cabinet with a capacity of 100% of key changes on project plus 25% expansion, tags, envelopes, loan register and cards. System to be equal to Key Control Systems, Inc. "PLR" system. Equal products by Telkee or Lund are acceptable.

PART 3 - EXECUTION

INSTALLATION

Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by architect.

- 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the DOOR AND HARDWARE INSTITUTE.
- 2. WDMA Industry Standard I.S. 1.A-97, "Hardware Locations for Wood Flush Doors."

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9. Do not install surface-mounted items until finishes have been completed on the substrates involved.

17-189

FINISH HARDWARE

08700-5

Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

<u>Weatherstripping and</u> <u>Seals</u>: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

ADJUSTING AND CLEANING

Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.

Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper functions and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

Clean adjacent surfaces soiled by hardware applications.

HARDWARE SCHEDULE

<u>Note</u>: Hardware for all doors will be furnished regardless of schedule for a complete project. If a door is left out of the schedule, it will be the supplier's responsibility to include this in his estimate at no additional charge to the owner, architect, or contractor.

Hardware Set 1: Exterior Metal Door

1 ea. Continuous Hinge	SL11HD x 83" CL
1 ea. Exit Device	98NL x VR910NL - 630
1 ea. Door Closer	4111-CUSH x AL - TB
1 ea. Rim Cylinder	11-34 x 626
1 ea. Kick Plate	10" x 2" LDW - 630 .050
1 ea. Threshold	2005AT – LAR
1 ea. Rain Drip	346C - LAR
1 ea. Set Weatherstripping	303AS x LAR

END OF SECTION 08700

SECTION 09900 - PAINTING

PART <u>1 -</u> <u>GENERAL</u>

DESCRIPTION OF WORK:

<u>Extent</u> of painting work is indicated on drawings and schedules, and as herein specified including accent painting.

Work includes painting and finishing of interior except as otherwise indicated.

1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatments specified under other sections of work.

<u>Work includes</u> field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.

<u>"Paint"</u> as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

<u>Surfaces to be Painted</u>: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.

Following categories of work are not included as part of field-applied finish work.

- 1. <u>Pre-Finished Items</u>: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.
- 2. <u>Concealed Surfaces</u>: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
- 3. <u>Finished Metal Surfaces</u>: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.

4. <u>Operating Parts</u>: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.

Following categories of work are included under other sections of these specifications.

- 1. <u>Shop Priming</u>: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
- 2. Unless otherwise specified, shop priming of fabricated components such as shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.

Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

QUALITY ASSURANCE:

<u>Single Source Responsibility</u>: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

<u>Coordination of Work</u>: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

SUBMITTALS:

<u>Product</u> <u>Data</u>: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.

<u>Samples</u>: Prior to beginning work, Architect will furnish color chips for surfaces to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's re- view of color and texture only.

Provide a listing of material and application for each coat of each finish sample. Provide a 4' x 4' sample application of each color paint for Architect's approval prior to final ordering of product. Sample application shall be applied in an inconspicuous place, satisfactory to the Architect.
DELIVERY AND STORAGE:

<u>Deliver</u> <u>materials</u> to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

- 1. Name or title of material.
- 2. Fed. Spec. number, if applicable.
- 3. Manufacturer's stock number and date of manufacturer.
- 4. Manufacturer's name.
- 5. Contents by volume, for major pigment and vehicle constituents.
- 6. Thinning instructions.
- 7. Application instructions.
- 8. Color name and number.

<u>Store materials</u> not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.

1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

JOB CONDITIONS:

<u>Apply water-base paints</u> only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degree F and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.

<u>Apply solvent-thinned paints</u> only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degree F and 95 degree F, unless otherwise permitted by paint manufacturer's printed instructions.

<u>Do not apply paint</u> in snow, rain, fog or mist, or when relative humidity exceeds 85% or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

PART 2 – PRODUCTS

<u>Manufacturers</u>: The following manufacturers' are listed as acceptable substitutions to the establish minimum standards. Sherwin Williams Products are listed as the standard of product performance and quality.

17-189

Sherwin Williams Paint Company (SW) Dulux Paint Company Benjamin Moore and Co. (Moore). Pittsburgh Paints (PPG). Pratt and Lambert (P & L).

Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than five (5) days prior to scheduled bid opening.

MATERIALS:

<u>Material Quality</u>: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

- 1. <u>Proprietary names</u> used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
- 2. <u>Federal Specifications</u> establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.
- 3. <u>Manufacturer's products</u> which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

<u>Color</u> <u>Pigments</u>: Pure, non-fading, applicable types to suit substrates and service indicated.

PART <u>3 – EXECUTION</u>

INSPECTION:

Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator. If work is begun before satisfactory conditions are met, than it shall be the Applicators' responsibility for the finish surfaces conditions.

Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

SURFACE PREPARATION:

<u>General</u>: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

- 1. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.
- 2. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
- 3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

<u>Ferrous</u> <u>Metals</u>: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

1. <u>Touch-up shop-applied prime coats</u> wherever damaged or bare. Clean and touch-up with same type shop primer.

<u>Galvanized</u> <u>Surfaces</u>: Clean free of oil and surface contaminants with non-petroleum based solvent.

MATERIALS PREPARATION:

Mix and prepare painting materials in accordance with manufacturer's directions.

<u>Maintain containers</u> used in mixing and application of paint in a clean condition, free of foreign materials and residue.

<u>Stir materials</u> before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if

APPLICATION:

<u>General</u>: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

- 1. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.
- 2. Provide finish coats which are compatible with prime paints used.
- 3. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness not less than specified thickness.
- 4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.

<u>Scheduling</u> <u>Painting</u>: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss adhesion of the undercoat.

<u>Minimum</u> <u>Coating</u> <u>Thickness</u>: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

<u>Prime</u> <u>Coats</u>: Apply prime coat where required to be painted or finished, and which has not been primed coated by others.

1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

<u>Completed</u> <u>Work</u>: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

FIELD QUALITY CONTROL:

The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:

- 1. Engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.
- 2. Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative materials analysis.

If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

CLEAN-UP AND PROTECTION:

<u>Clean-Up</u>: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each day.

Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

<u>Protection</u>: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

EXTERIOR PAINT SCHEDULE;

<u>General</u>: Provide the following paint systems for the various substrates, as indicated.

<u>Ferrous</u> <u>Metals</u>: Gloss Alkyd Enamel: 2 Finish coats over primer with total dry film thickness of not less than 6.0 mils.

Pro-Cryl® Universal Acrylic Primer B66-310 Series
(2.0 - 4.0 mils dry per coat)
Industrial Enamel, B54 Series
Industrial Enamel, B54 Series, (2-4 mils dry per coat)

Zinc-Coated Metal: Gloss Alkyd Enamel: 2 Finish coats over primer with total dry film thickness of not less than 2.5 mils.

1st Coat:	Pro-Cryl® Universal Acrylic Primer B66-310 Series	
	(2.0 - 4.0 mils dry per coat)	
2nd Coat:	Industrial Enamel, B54 Series	
3rd Coat:	Industrial Enamel, B54 Series, (2-4 mils dry per coat)	

END OF SECTION 09900

SECTION 10520 - FIRE EXTINGUISHERS AND ACCESSORIES

PART <u>1 -</u> GENERAL

DESCRIPTION OF WORK:

<u>Definition</u>: "Fire extinguishers" in this section refers to units which can be hand-carried as opposed to those which are equipped with wheels or to fixed fire extinguishing systems, unless otherwise indicated.

Type of products in this section include:

1. Fire extinguishers and wall brackets.

<u>UL-Listed</u> <u>Products</u>: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

<u>FM</u> <u>Listed</u> <u>Products</u>: Provide new portable fire extinguishers which are approved by Factory Mutual Research Corporation for type, rating, and classification of extinguisher indicated and carry appropriate FM marking.

SUBMITTALS:

<u>Product Data</u>: Submit manufacturer's technical data and installation instructions for all portable fire extinguishers required. For fire extinguisher cabinets include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Where color selections by Architect is required include color charts showing full range of manufacturer's standard colors and designs available.

PART 2 - PRODUCTS

<u>Manufacturers</u>: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

J.L. Industries. Larsen's Mfg. Co. Modern Metal Products

Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than five (5) days prior to scheduled bid opening.

FIRE EXTINGUISHERS:

<u>General</u>: Provide fire extinguishers and standard wall brackets for each extinguisher indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

1. <u>Abbreviations</u> indicated below to identify extinguisher types related to UL classification and rating system and not, necessarily, to type and amount of extinguishing material contained in extinguisher.

<u>Multi-Purpose</u> Dry Chemical Type (4A-80BC-FE): UL-rated 4-A; 80-BC, I0 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires, equal to Cosmic 10E by J. L. Industries. "Start –Up Tags" for each fire extinguisher must be provided and approved by Local Fire Department before Final Inspection.

PART <u>3 – EXECUTION</u>

INSTALLATION:

<u>Install items</u> included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.

- 1. <u>Prepare</u> walls for fire extinguisher as required by type and size of bracket to comply with manufacturer's instructions.
- 2. <u>Securely fasten mounting brackets and fire extinguisher to structure,</u> square and plumb, to comply with manufacturer's instructions.
- 3. Where exact location of bracket-mounted fire extinguishers is not indicated, locate as directed by Architect.

END OF SECTION 10520

These specifications sections were prepared by and under the direct supervision of the Engineer of Record for this project.

<u>Division 15 – MECHANICAL</u> 15010 Mechanical General Provisions 15700 Heating, Ventilating & Air Conditioning



September 25, 2017

SECTION 15010

GENERAL MECHANICAL PROVISIONS

PART 1. GENERAL

- 1.1. <u>General Requirements:</u> Division One is applicable in full hereto. For the purpose of this specification the word "provide" shall mean, "furnish and install, complete and ready for use". No materials or products that contain asbestos, formaldehyde, lead or mercury, in excess of limits mandated and defined by OSHA, LEED and the EPA, shall be utilized.
- 1.2. <u>Buy American:</u> The Manufacturers of all Division 15 items shall be in compliance with the Buy American Act and the American Recovery and Reinvestment Act of 2009. Exceptions will be allowed where certain items are not available. Ex., VRF equipment and certain porcelain products. Where three (3) U.S. Manufacturers can meet the requirements of these specifications, their products shall be provided. During the submittal phase of the project, the respective Manufacturer shall provide a conformance letter from an Officer of the Manufacturer's Board of Directors, on company letterhead, that indicates compliance with the aforementioned Acts. Failure to provide the compliance letter at the submittal stage will be cause for automatic rejection of the submittal.
- **1.3. Spare Parts:** Manufacturer of any equipment specified shall have a wholesale outlet for readily available replacement parts in the nearest major USA city.
- 1.4. <u>Codes and Standards and Listings</u>: Comply with all current editions of all referenced publications within these specifications and all current editions of applicable NFPA, ASME, OSHA, IBC, ASHRAE, ASTM, ASME, ANSI, SMACNA, Americans with Disabilities Act (ADA), 2010 ADA Standards for Accessible Design, with Local Building Codes, Mechanical Codes, Gas Codes, Plumbing Codes, ANSI/ASHRAE/IESNA Standard 90.1 (2013), International Energy Conservation Code, International Fuel Gas Code, International Fire Code, Americans with Disability Act Accessibility Guidelines and with all applicable local ordinances and codes. Equipment shall bear Underwriters Laboratories Inc. (UL) listing label, Canadian Standards Association (CSA) listing label or ETL approved rating. All electrical components and products shall also comply with the respective Code of Federal Regulations (CFR).

Where conflicts occur between a Code, Standard or Listing and the contract drawings or contract specifications, the most stringent requirements shall govern and be applied. Advisory provisions listed in all Codes referenced in the Contract Documents shall be considered mandatory.

1.5. <u>Permits:</u> Provide all permits, pay all fees and arrange for inspections as required by all applicable Governing Authorities. Furnish certificates of all inspections and approvals from all Governing Authorities. Provide additional materials, parts, methods, etc. and modify the work as required by Governing Authorities' Inspections and Regulations. Correct all deficiencies required by Code officials at no additional cost to the Owner or the Owner's Project Design Professionals.

The Plumbing and/or Mechanical Contractor, as applicable, shall arrange and pay for the State of Alabama Boiler and Pressure Vessel Safety Division inspector to visit job site to inspect water heater and/or boiler installation and obtain written approval and certification as required.

1.6. <u>Inspections:</u> It is the contractor's responsibility to have the job ready for inspections when they are scheduled. If the project is not ready for the requested inspection and the Architect, any governmental agency or any other entity requires a re-inspection, the contractor shall pay Zgouvas, Eiring & Associates a re-inspection fee of \$1,500. The payment shall be made directly to Zgouvas, Eiring & Associates 5 days prior to the scheduled re-inspection.

The Contractor shall also refer to Paragraph "Identification" in this Section of the specifications and note that identification is required to be completed before certain inspections.

1.7. Drawings: In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, all required appurtenances for ducts and equipment with the architectural and electrical drawings, and lay out work so as to fit in with ceiling grids, lighting and other parts. Make minor adjustments in the field as required to provide the optimum result to facilitate ease of service, efficient operation and best appearance. Where doubt arises as to the meaning of the plans and specifications, obtain the Architect's decision, in writing, before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question. DO NOT SCALE the drawings. The various scales used on the drawings do not allow for all fittings, offsets and accessories that may be required to complete the work. The Contractor shall carefully investigate the conditions that would affect the work to be performed and shall arrange such work as necessary to comply with the intent of the construction documents. Refer to Architectural drawings for dimensions and verify scale shown on the drawings. All drawings are diagrammatic and are intended to quantify the materials specified and indicate their intended relationship to each other. The drawings and specifications are complementary and work shown, but not specified, or specified, but not shown, shall be the same as though required by both.

The Contractor shall carefully examine the contract documents during the bidding phase. Any missing information in the contract documents that is required for obtaining accurate pricing shall be brought to the attention of the Architect, **prior to bid date**, so all may be clarified and/or corrected. Failure to identify and resolve the issues prior to bid shall require the Contractor to provide said items, complete, without additional cost to the Owner or the Owner's Project Design Professionals, using materials and methods specified by, and as directed by, the Owner's Design Professionals.

1.8. <u>Conflicts, Coordinations and Changes:</u> In the event that interferences or conflicts occur, the Architect shall decide which equipment shall be relocated regardless of which was first installed. In the interest of avoiding such conflicts, each Sub-Contractor who is using common space, etc., shall coordinate his work with all other trades and other parts of his own work. If, during this coordination, it is discovered that necessary or desirable changes should be made, advise the Architect and secure his decision in writing. Do not fabricate any duct nor install any pipe until all coordination has been accomplished.

Mechanical and Electrical Improvements for The Lawrence County BOE **1.9.** <u>Coordination Drawings:</u> Follow procedures set forth in Division One. Before starting work, submit for approval, coordination shop drawings showing proposed arrangement of equipment, ducts, power requirements, and controls. As a minimum, submit detail layouts of potential conflicts. Refer to subsequent Sections for additional specific requirements.

Failure to submit shop drawings will make the Contractor responsible for changes required to facilitate installation of, and the proper operation of, all systems at no additional cost to the Owner or the Owner's Project Design Professionals.

1.10. <u>Maintenance, Replacement and Service Access:</u> Locate equipment as shown on the plans. The Contractor shall install equipment, valves, piping, etc. with the maintenance, service and replacement access required by the Manufacturer of the respective installed item. All items shall be installed to provide maximum safety, service, replacement and maintenance access. All piping with valves, mechanical equipment and other items that may require maintenance, service or replacement, shall be located no more than 24" above the finished ceiling and no more than 14'-0" above finish floor in areas without ceilings, to ensure proper access.

Coordinate all questionable access or location of items which may present a nuisance, if installed as specified above, with the Engineer or the Architect's field representative prior to installing any item; else, relocation will be at the Contractor's expense once discovered.

- **1.11.** <u>Warranty:</u> Guarantee in writing to make good without cost any defects in materials and workmanship for one year following the date of acceptance of the project. Provide free maintenance and service during the guarantee period. See other Division 15 Sections for additional requirements for guarantee of air conditioning compressors, air filter replacement, etc.
- **1.12. Submittal Data:** Partial or incomplete submittals will not be reviewed. Within 25 days after award of the contract, submit for approval a complete schedule of material and equipment proposed. When incomplete schedules of materials and equipment are submitted, the Contractor is responsible for providing all items as specified. Include catalog data, scheduled capacities, fan curves, sound data, etc.

Item Manufacturers not named in the specifications require prior approval. Follow procedures set forth in Division 1 of the specifications. Where substitutions are proposed, unless the Contractor states in writing, on a separate summary sheet in the front of the respective submittal, the differences of the substituted equipment or material, he shall be held responsible to replace such items any time discrepancies are found.

All submittals shall be separately bound into a 3-ring binder (if provided in hard copy) or in pdf format (if provided electronically). Submittals shall be indexed and tabbed. Refer to the Architectural General Conditions and Division 1 for the format required by the Architect.

A cover sheet shall be provided in the front of the submittal package which states, as a minimum, the Project name and location, the name of the Owner, the Architectural firm, the Engineering firm, the General Contractor, the Mechanical Contractor and each

Contractors' point of contact, with phone number. A summary sheet shall be inserted at the beginning of each tabbed section to summarize the contents of each respective tabbed section. The summary sheet shall include any items that have been changed or removed due to Project cost constraints, addendums or Value Engineering (VE). Include materials used, methods of installation, product manufacturer, equipment capacities, etc. HVAC equipment items shall follow the identical tabular format, category by category, shown on the HVAC equipment schedules. As a minimum, the summary sheet shall indicate the submitted values compared to all of the specified values. Failure to provide the submittals in the format specified will be cause for automatic rejection without review. Plumbing and Fire Protection submittals shall follow the identical procedure specified for the Mechanical Contractor

The General Contractor shall review and approve all submittals prior to submitting them to the Architect. Submittals without the General Contractor's approval will be rejected without review.

- **1.13.** <u>Site and Existing Conditions:</u> Bidders shall visit the site and become acquainted with all job conditions. Report to the Architect, prior to bid, any conditions that are required to accomplish the installation of all systems. Provide for required adjustments to complete the intent of the work. No consideration will be given after bid opening for alleged misunderstanding regarding job conditions, utility connections, permits, fees, etc.
- **1.14.** <u>Line Locators:</u> Before proceeding with excavating or trenching, arrange with the Owner, all utility companies, and line locating firm(s) to describe and mark all of the systems which might be damaged by construction operations.
- **1.15. Phasing:** Interrupt existing services only at times approved by the Architect and the Owner. The General Contractor shall provide a written request to the Architect and the Owner for permission to interrupt services to the facility. The request shall be provided a minimum of seven (7) days prior to the desired date of the interruption. Hold interruptions to a minimum in duration and frequency.
- **1.16.** <u>**Record Drawings:**</u> Provide in such detail, as is set forth under General and Supplemental Conditions.

Keep an accurate record of changes made during construction. Transfer these changes to a set of reproducible copies of original drawings that the Architect will sell to Contractor at printing cost. The drawings will be provided to the Contractor "As Is". The Contractor is responsible for providing and showing all changes to the drawings that are different from the original contract drawings, including but not limited to addendums, change-orders, VE items, etc. HVAC plans may be a set of reproducible copies of the final corrected contract drawings. When work is completed, submit corrected reproducible drawings to the Architect for record and include copies in the Owner's Operating and Maintenance Manual.

As-built drawing files shall also be provided in digital format on CD-R type CD(s). The drawings will be provided to the Contractor "As Is". The Contractor is responsible for providing and showing all changes to the drawings that are different from the original contract drawings, including but not limited to addendums, change-orders, VE items, etc.

PART 2. WORK RELATED TO OTHER TRADES

- 2.1. <u>Foundations and Supports:</u> Mechanical Contractor shall provide foundations, supports, etc. not specified under other Divisions and as required to mount all items in a safe, sound, professional and structurally sound manner. The respective Contractor shall provide all supplemental steel between various types of structural members, including between bar joists, purlins, miscellaneous structural items, etc. as required for the item(s) proper support. Where the Contractor has doubt as to proper supporting requirements, he shall consult with and seek the guidance of the Architect and the project Structural Engineer. Consult all contract documents pertaining to other trades to determine extent of their work.
- 2.2. Access Panels and Doors: Furnish to General Contractor for installation wherever required for access to valve, damper, air vent, cleanout, smoke detector or similar device. Doors shall be suitable for wall or ceiling finish involved, 16" x 16" unless otherwise indicated or as required to permit removal of equipment and/or provide acceptable maintenance access. Access panels and doors shall be fire rated where rated assemblies are penetrated. Access panels and doors for items located outdoors shall be weatherproof. Identify all access panels and doors to indicate item for which access is provided. Ex. Motorized damper, fire damper, filters, etc. Additionally, add the following to each access panel identifier: "DO NOT BLOCK". See specification section "Miscellaneous Requirements, Identification" for materials and methods required. Access panels and doors shall be as manufactured by Milcor, Philip Carey, Zurn or other approved equal. The Architect must approve proposed types which are to be installed in areas which are exposed to view and in finished areas. Exposed access panels and doors shall be factory cleaned and primed for painting in the field. Colors shall be as selected by the Architect. Refer to Architectural Section, Painting, for additional information.
- 2.3. <u>Cutting and Patching:</u> Openings are to be laid out and built-in. Furnish detailed layout drawings to other trades in advance of their work. Failure to furnish layout shop drawings to General Contractor shall make the Mechanical Contractor responsible to rebuild openings as directed by the Architect.
- 2.4. <u>Painting and Finishing:</u> Clean and paint with two coats of black latex paint all exposed ferrous metal parts of hangers, unistrut and other assemblies used for supporting of ducts (except duct straps/band hangers). Bare, unprotected/uncoated steel or galvanized hangers, brackets, unistrut, supports, etc., are not allowed. In lieu of painting, the Contractor may substitute factory painted, powder coated or epoxy coated items to prevent rusting of the items listed above. All paints and coatings shall comply with 25/50 smoke and flame spread requirements. Also, see specification section, "Identification" for additional requirements.

Painting of ducts, grilles, diffusers and other surfaces in finished areas is specified in Architectural Section "Painting" or similar section. Refer to those sections for additional requirements. Where the Architectural specifications require items to be painted, the Contractor shall furnish it with a factory applied prime coat from the Manufacturer of that item.

Where factory finished items are marred, scratched or damaged, replace the item, or upon approval from the Architect or Owner, refinish or touch-up as required to bring to a like new condition.

PART 3. EXCAVATION, TRENCHING & BACKFILLING

3.1. Broken Pavement: In public streets or on the project site, backfill and repair to satisfaction of authorities having jurisdiction and the Architect.

PART 4. MISCELLANEOUS REQUIREMENTS

- 4.1. <u>Materials and Equipment:</u> New and of best quality in every respect. Pipe and fittings shall conform to the ASTM Standard designated for pipe of each material. Equipment shall bear Underwriters Laboratories Inc. (UL) listing label, Canadian Standards Association (CSA) listing label or ETL approved rating. All electrical components and products shall also comply with the respective Code of Federal Regulations (CFR). All pressure vessels shall be constructed and tested in accordance with applicable ASME Codes and shall bear ASME stamps unless specified otherwise. Where conflicts occur between a Code, Standard, Listing and the contract drawings or contract specifications, the most stringent requirements shall govern and be applied. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer, however, the component parts of each unit need not be.
- **4.2.** <u>Workmanship:</u> First class, premium and in accordance with best practice. Work shall be executed by experienced mechanics and shall present a neat appearance. Install all equipment in accordance with manufacturer's recommendations. Absolute coordination is required with the other Contractors on the project before proceeding with installation of any system or item.

At all stages of installation, protect openings, fixtures, ductwork, coils and equipment against the entrance of foreign materials and from damage by the elements, mortar, paint, etc... If air moving equipment must be used during construction, temporary filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-2012, and shall be installed at each return air grille, return air register, exhaust grille, exhaust register, and unit return air inlet. ALL open portions of ductwork and equipment shall be covered with a self-adhesive film (not visquein) or airtight sheetmetal caps to prevent the intrusion of contaminates. All equipment openings, duct taps, duct take-offs, etc., shall be protected immediately after the tap, take-off, etc. has been fabricated in the field. In effect, there shall be no ductwork opening or equipment opening that is exposed to the ambient air. The material shall be a minimum of 3 mils thick and have a minimum tensile strength of 10 psi. It shall be waterproof and recyclable. Material shall be DuroDyne Dyn-O-Wrap or approved equivalent. Where bare sheetmetal is delivered unassembled to the job site, all ductwork shall be covered and protected with visquein. After fabricating the duct in the field, the interior bare metal shall be wiped clean with a clean damp cloth before erection in the field. After erection, duct shall be protected as specified above. Any ductwork discovered to be unprotected as specified is subject to immediate rejection for use on this project.

- **4.3.** <u>Factory Finishes:</u> Furnish to the Architect, color cards for standard and premium colors available. The Architect shall select color where choices exist. Provide Manufacturer's standard color where color choices are not available. Coordinate all color selections with appropriate Architectural specification sections.
- **4.4. Expansion:** Provide for expansion and contraction of all ductwork, etc. and make proper provisions so that excessive strain will not occur on ductwork or other parts. Provide flexible connections for all ductwork at all building expansion joints.
- **4.5.** <u>Safety Provisions:</u> Provide covers or guards on all hot, moving and projecting items that could be construed as a hazard to occupants of the building or to service personnel.

Identification: All equipment, smoke detectors, access panels, motor starters, disconnects, thermostats, humidistats, sensors, other control systems components, control switches, and related devices shall be equipped with engraved laminated plastic nameplates, as described below, but not less than 1/4" high. Provide identification for all access doors as specified hereinbefore. Refer to Paragraph "Access Panels and Doors" above for requirements.

Labels shall be a minimum of 4" x 3" x 1/16" thick, laminated plastic labels (larger if needed) with 1" high x 1/4" stroke numerals and all capital letters to identify all equipment furnished under this Section. Labels attached to the ceiling grid shall be the same width as the ceiling grid it is attached. Properly adjust lettering height to fit within the smaller width label. Red with white lettering or white with red lettering as required for maximum contrast with color of the equipment. In finished areas where identification is attached to the ceiling grid, the Architect shall select colors of materials. Engrave equipment designation and numbers as shown on plan and drawings on upper half of tag, leaving lower half of tag for future engraving by Owner.

Permanently affixed warning labels shall be attached to all equipment, on a highly visible location on the equipment, which can be automatically started. The warning label shall read as follows: "CAUTION!! This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect switch to "OFF" position before servicing or attempting to work on equipment". Permanently affixed warning labels shall be attached to all motor starters and all control panels which are connected to multiple power sources utilizing separate disconnect switches. The warning labels shall read as follows: "This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing or working on this item".

4.6. <u>Delivery and Storage</u>: All equipment and materials delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants. See Section 15700 and this Section 15010 for additional requirements for ductwork and equipment.

END OF SECTION

Mechanical and Electrical Improvements for The Lawrence County BOE

SECTION 15700

HEATING, VENTILATING AND AIR CONDITIONING

PART 1. GENERAL

- 1.1. <u>General Provisions</u>: Section 15010 is applicable in full hereto. No materials or products that contain asbestos, formaldehyde, lead or mercury, in excess of limits mandated and defined by OSHA, LEED and the EPA, shall be utilized.
- **1.2.** <u>Qualifications of Subcontractor</u>: Must be properly licensed and established as a Heating and Air Conditioning Contractor at location of the work and shall maintain locally adequate service facilities. He shall have had previous experience in the satisfactory installation of at least six (6) systems of this type, size and scope.
- **1.3. Scope:** Include all equipment, material, and labor required for complete and satisfactory operation of HVAC systems, even though not every item involved is indicated. Do not attach any items to other trades' assemblies. Items shall be attached to building structural system. Advisory provisions listed in all Codes referenced in the Contract Documents shall be considered mandatory. Where conflicts occur between a Code, Standard, the contract drawings or specifications, the most stringent requirements shall govern and be applied. Refer to other sections of this specification and Section 15010 for additional information and requirements.
- 1.4. <u>Buy American:</u> The Manufacturers of all Section 15700 items shall be in complete compliance with the Buy American Act and the American Recovery and Reinvestment Act of 2009. Exceptions will be allowed where certain items are not available. Ex., VRF equipment. Where three (3) U.S. Manufacturers can meet the requirements of these specifications, their products shall be provided. During the submittal phase of the project, the respective Manufacturer's Board of Directors, on company letterhead, that indicates compliance with the aforementioned Acts. Failure to provide the compliance letter at the submittal stage will be cause for automatic rejection of the submittal.
- **1.5.** <u>Miscellaneous:</u> The Contractor shall carefully examine the contract documents during the bidding phase. Any missing information in the contract documents that is required for obtaining accurate pricing shall be brought to the attention of the Architect, **prior to bid date**, so all may be clarified and/or corrected. Failure to identify and resolve the issues prior to bid shall require the Contractor to provide said items, complete, without additional cost to the Owner or the Owner's Project Design Professionals, using materials and methods specified by, and as directed by, the Owner's Design Professionals.
- **1.6.** <u>Painting and Colors:</u> Furnish to the Architect, color cards for standard and premium colors available. The Architect shall select color where choices exist. Refer to Architectural Painting Section of the specifications for additional requirements.
- **1.7.** <u>Safety Provisions:</u> Provide covers or guards on all hot, moving and projecting items that may be deemed by the Engineer, Architect or Owner to be a hazard to occupants of the building or to service personnel.
- **1.8. Spare Parts:** Manufacturer of any equipment specified shall have a wholesale outlet

for readily available replacement parts in the nearest major USA city.

- 1.9. Submittals: Refer to Section 15010 for requirements.
- 1.10. <u>Identification:</u> Refer to Section 15010 for identification requirements. There are specific requirements prior to the above ceiling and final inspections, respectively, that are mandatory. The identification section of the specification is extensive. The Contractor shall refer to Section 15010, review and provide all identification requirements specified.
- **1.12.** <u>Service, Charges, Grease, Filters, etc.</u>: Furnish complete first charges of refrigerant, grease, oils, etc., and be responsible for such full charges for the guarantee period. Provide service and maintenance for all equipment and systems during the guarantee period. As a minimum, quarterly service calls and reports are required. Make last service call two weeks prior to year-end inspection. All quarterly service shall include lubrication of all motors, bearings, calibration and adjustment of all controls, belts, etc. The Contractor shall furnish to the Architect and the Owner individual written service reports for all work done under this warranty. Failure to provide the Architect with the Owner's written acknowledgement of service calls shall be construed to mean that the service calls have not been accomplished and are still required.
- **1.13.** <u>Field Instructions</u>: The Contractor shall operate all systems for a period of six (6) days after completion of the work. During this time, provide competent personnel to thoroughly instruct representatives of the Owner in the proper operation and care of all equipment and control systems. Secure written acknowledgement of such training from the Owner. Failure to provide the Architect with the Owner's written acknowledgement of this training shall be construed to mean that the instructions have not been accomplished and are still required.
- **1.14. Bound and Framed Instructions:** Two weeks before final inspection, furnish three complete sets of operating and maintenance instructions, bound in hard cover, indexed and tabbed. The first sheet in the bound instructions shall be a list with each product, name, address and telephone number of:
 - a. Subcontractor and installer
 - b. Table of Contents listing all products in the order that they appear in the specifications. Label each tab accordingly. Each item (HP-A, AHU-1, EF-A, etc.), individually, shall be included.
 - c. Local source of supply for parts and replacement
 - d. Provide wiring and control diagrams with explanatory data; control sequence describing start-up, operation and shutdown; operating and maintenance instructions for each piece of equipment; manufacturer's bulletins and catalog data; parts list and recommended spare parts. Fold in large sheets of drawings.
 - a. A general maintenance section shall be included. Provide a list indicating all routine maintenance procedures based on the respective manufacturer's recommended intervals. As a minimum, maintenance shall be grouped and individually tabbed to indicate maintenance operations required:
 - 1. Once a month
 - 2. Quarterly
 - 3. Once every six months
 - 4. Once a year

- e. Provide drawings of system control and wiring diagrams, condensed operating instructions, and lubricating schedule and include in binder. All components shall be numbered and identified on diagram. Submit for approval. After approval, place in the binder. Also, frame under glass or plastic and mount in each mechanical room in an optimally viewed location.
- f. Record drawings of the HVAC drawings in hard copy and PDF format.
- g. Copy of Test and Balance Report to include testing of fire dampers, etc. as specified.
- h. Provide copy of results of all tests specified.
- i. Provide copy of all start-up reports specified.
- j. Provide Owner's letter certifying training of Owner's personnel in the operations of the HVAC systems has been accomplished.

Additionally, the Contractor shall provide all of the aforementioned information, in digital Adobe Acrobat PDF format, on a CD-R CD. The PDF file shall be provided with an embedded index for each item specified. It shall appear in the left hand window of the opened document so that the Owner or his maintenance personnel can "click" on the indexed item and move immediately to that specific item.

1.15. <u>Warranty</u>: Guarantee work as set forth in Section 15010 and Division 1. Provide free maintenance and service during the guarantee period.

PART 2. ELECTRICAL WORK AND EQUIPMENT

- 2.1. <u>Power</u>: All power wiring required for installation of equipment is specified under Electrical Division. Electrical equipment shall be compatible with the current shown on electrical drawings. Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.
- 2.2. Motors: All motors furnished shall be designed, manufactured, and tested in accordance with the current applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the current applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed The Consortium for Energy Efficiency (CEE) Premium Efficiency[™] full load efficiencies. All motors shall be listed under UL recognized component file as applicable. All motors shall be suitable for installation according to the requirements of NEC. Motors shall be wound for the specified voltage and a 1.5 service factor, 1750 RPM open drip proof construction unless otherwise shown or specified. The bearings shall have a rated fatigue life of B-10 of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications minimum. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG 1. Load on motors shall not exceed 100% nominal horsepower. Routine factory testing shall be conducted in accordance with Method B of IEEE 112 (current edition), Standard Test Procedure for Polyphase Induction Motors and Generators and shall be as described in Article 12.55 of NEMA MG1, Motors and Generators. Premium efficient motors shall be warranted for 36 months from date of acceptance of the project.

Where shown, specified or required, furnish increment wound motors for two-step starting. All motors shall be provided with overload protection and phase protection on all legs. Do not run motors until correct overload elements are installed in starters. Trading overload elements for elements of correct size for motors actually furnished shall be included in this Section. Motors shall be by Allis Chalmers, General Electric Goulds, Louis Allis, Westinghouse or approved equivalent. All motors serving outdoor

equipment exposed to weather shall have TEFC motors meeting the requirements set forth previously.

- **2.3. <u>Fusing</u>**: Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.
- 2.4. <u>Motor Starters</u>: To be furnished under this Section; installation thereof is specified under Electrical Division, except for those which are specified to be factory assembled. Starters shall be Cutler-Hammer, Allen-Bradley, Square D or General Electric. Starters shall be U.L. and NEMA approved. Where required for interlocks provide built-in step down transformer. Motors for VFD drives shall be designed for NEMA MG-1, Part 30.

Provide for each motor or group of motors requiring a single control (and not controlled from a motor-control center), a suitable controller and devices that will function as specified for the respective motors.

Provide overload protection for each ungrounded conductor to each motor 1/8 HP or larger (manual reset type unless indicated otherwise). The overload-protection device shall be integral with the motor or controller. Unless indicated otherwise, furnish pilot lights with all remote starters. Where auxiliary control devices are connected into control circuit, these devices shall not bypass safety controls (motor-overload protective devices, high-pressure cutouts, low pressure cutouts, etc.). Provide "Hand - Off - Auto" switches, auxiliary contacts, etc. for all starters.

- 2.5. Phase Protection: All fan motors, indoor units, outdoor units, condensing units, packaged units, etc., shall be provided with surge protection and phase protection to insure against voltage unbalance, over/under voltage, phase loss, reversal, incorrect sequencing and rapid short cycling. Protection shall be provided for all 3-phase equipment utilizing ICM Controls Model 450 or equivalent. All single phase equipment with horsepower greater than or equal to 1/8 HP shall be provided with protection utilizing ICM Controls Model ICM 492 or equivalent. The Contractor shall consult with the Owner's maintenance personnel and set up all programmable options based on the Owner's requirements, within the device's capabilities. Phase protection is not required on equipment being controlled via a variable speed frequency drive; if the specified protection is inherent with the variable speed drive furnished.
- 2.6. <u>Controls:</u> HAC Contractor shall be responsible for the furnishing and installation of all controls, and control and interlock wiring, as specified or required to properly complete the installation. Control conduit is specified in Electrical Division of the specifications and/or shown on electrical drawings. Minimum control conduit size shall be 3/4". All control conduit, power wiring, relays, contactors, etc. for controls, which are not shown on the electrical drawings or specified in the Electrical Division of the specifications, shall be provided under this HVAC Section. Coordinate all requirements with the Electrical Sub-Contractor prior to bid. All thermostat and humidistat boxes shall be mounted 46" A.F.F. to the center of the box (ADA height). All work shall be done by an approved, independent HVAC Controls Subcontractor whose primary business is the installation and servicing of HVAC controls systems.
- 2.7. <u>Controls and Instrumentation Cable:</u> Instrumentation cable shall be minimum AWG as recommended by the controls system manufacturer. Cable shall be stranded copper, single or multiple twisted, minimum 2 inch lay of twist, 100 percent shielded pairs and shall have 300-volt insulation. Each pair shall have a tinned

copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum polyester or tinned copper cable shield tape, overall AWG as recommended by the controls system manufacturer, tinned copper cable drain wire and overall cable insulation. All wiring and cable shall be in metallic conduit except conduit is not required above lift-out (lay-in) ceilings. Minimum conduit size shall be 3/4". Provide independent, minimum 2" wide, aluminum or rust resistant coated steel J-hook supports for all wiring not in conduit. Wiring supports shall be attached to the building structural system (not other trades' supports, piping, duct, ceiling suspension system, etc). Wiring, cabling, etc., shall be neatly bundled together and supported at no more than four (4) feet on center. All wiring, cabling, conduit, etc., shall be plenum rated and rated for use at temperatures and conditions expected in the location of mounting.

- 2.8. <u>Wiring Diagrams:</u> Furnish to the Electrical Contractor for the specific makes and models of electric-motor operated equipment to be installed. Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.
- 2.9. <u>Modifications:</u> The cost of any modifications of the electrical power wiring and/or control wiring conduit required by heating, air conditioning or ventilation equipment or controls having electrical power requirements differing from that shown on the electrical drawings and/or as specified, shall be the responsibility of the Mechanical Contractor. Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.

PART 3. VIBRATION AND NOISE CONTROL

<u>General:</u> Elimination of objectionable vibration and noise is the responsibility of the Contractor, who must provide all foundations, isolators, flexible connections, air chambers, curbs, etc. required thereby. Pay special attention to vibration problems at year end inspection and correct all deficiencies noted.

PART 4. TESTING, START-UP, BALANCING, ETC.

- **4.1.** <u>General:</u> Conduct tests upon completion of the heating, ventilation and air conditioning installations, and at times as designated by the Architect. Furnish written reports to the Architect of all tests results. Provide copies of all test results in the Bound and Framed Instructions specified hereinbefore. Furnish all necessary personnel, test instruments, power, fuel, etc., as required to complete the specified requirements.
- **4.2.** Ductwork for Systems 2,000 CFM or Greater: Test all supply, return and exhaust ducts, plenums and casings and make airtight before covering with external insulation or concealing in masonry. Test supply ductwork under the positive pressure for the respective system. Test return and exhaust ducts, plenum and casing under a positive pressure of 0.75"WG. Maximum allowable leakage shall be 5%.Vacuum clean ducts, plenums, casings and coils. Demonstrate operation of fire dampers before testing and starting. Check that flexible connections are installed in folds (not pulled tight) and not transmitting vibration.
- **4.3.** <u>Performance Tests:</u> After cleaning, balancing, and testing are completed as specified, test each system as a whole to see that all items perform as integral parts of the system and that temperatures and conditions are evenly controlled throughout the building. Make corrections and adjustments as necessary to produce the

indicated conditions.

- **4.4.** <u>**Balancing:**</u> Check airflow at all supply, return and exhaust grilles, all diffusers and outside air intakes with a recently calibrated direct-reading velocity instrument. Adjust systems to deliver, supply air, return air or exhaust air quantities to within 5 percent of the indicated amounts. Provide instruments and otherwise assist Architect in checking balancing at final inspection.
- **4.5. Phase Protection Verification:** The Test and Balance Contractor, with cooperation from the Mechanical Contractor, shall verify that all phase protection specified has been installed where specified, and installed per the Manufacturer's requirements. The verification of this requirement shall be furnished in tabular form with findings included in the test and balance report. The summary shall list all equipment specified to have the protection, verification that the device is installed per the Manufacturer's requirementation and has been programmed to the Owner's requirements.

<u>Test Data:</u> Submit typewritten schedules of readings taken during the testing and balancing operations and a line diagram or plan of the system indicating specified quantities and final balanced quantities **two weeks prior to final inspection**. **No final inspection will be made without this data.** Report the required or specified reading, the first reading taken, and final balanced reading for the following items:

Fans: Size, type, speeding rpm, outlet velocity in fpm, static pressure inches water, air quantity in cfm, and motor load in amperes.

<u>Air Handling Equipment:</u> Size, type, fan speed in rpm, outlet velocity in fpm, external static pressure inches water, total static pressure inches water, air quantity cfm, and motor load in amperes.

<u>All Air Outlets and Inlets:</u> Size, velocity in fpm, and air quantity in cfm.

- **4.6.** <u>Control Settings:</u> Provide typed list indicating job setting of all automatic controls. Include settings of thermostats, humidity controls, CO2 sensors, safety controls, minimum damper settings, fire-safety thermostats, pressure controls, temperature controls, and other similar items. Tabulate to show type of control, location, setting and function. Verify that all safety settings and limits are appropriate and comply with current safety Codes and Regulations for the respective system.
- **4.7.** <u>Notification:</u> Notify the Architect one week prior to all testing. The Contractor shall provide all testing equipment and shall furnish written reports to Architect of all tests results. Additionally, provide copies in the Bound and Framed Instructions specified hereinbefore.

PART 5. SHEET METAL DUCT WORK (LOW VELOCITY 2" S.P.)

5.1. <u>Scope:</u> Provide as shown and as required for the air conditioning, heating and ventilation systems. Make changes in dimensions, offsets or crossovers as necessary to clear piping, lights and structural members, and to maintain scheduled headroom. Provide all accessories required. Refer to architectural drawings and specifications. Refer to Architectural section "Painting" for painting of exposed ductwork. In case of the absence of painting requirements in the aforementioned Specification Section(s), the interior and exterior of ductwork visible from any finished

space shall be cleaned, primed and painted as directed by the Architect. Ductwork visible through all grilles, registers, diffusers, ceilings, etc. shall be painted flat black with paint meeting ASTM E84 25/50 requirements. **Metal manufacturer's duct material stamp shall be visible on duct exterior surfaces. Any ductwork without the manufacturer's material stamp indicating sheet metal gauge thickness, material, etc., shall be cause for immediate rejection of the effected installation**

- 5.2. Protection of Interior of Duct from Debris: ALL open portions of ductwork shall be covered with a self-adhesive film or airtight sheet metal caps to prevent the intrusion of contaminates. All duct taps, duct take-offs, etc., shall be protected immediately after the tap, take-off, etc. has been fabricated in the field. When sections of sheet metal are delivered to the facility for fabrication in the field, which cannot be protected with the specified material, the sheet metal shall be covered with visquein. Prior to erecting same, ductwork shall be manually cleaned to remove all dust, dirt and construction debris. All ductwork shall be erected clean. After each section of ductwork is erected, immediately protect all openings as specified herein before. In effect, there shall be no ductwork opening that is exposed to the ambient air. The material shall be uV resistant, waterproof and recyclable. Material shall be DuroDyne Dyn-O-Wrap or approved equivalent. Any ductwork discovered to be unprotected as specified is subject to immediate rejection for use on this project.
- 5.3. <u>Protection of Interior of Ductwork When Any Air Moving Equipment is</u> <u>Operating During Construction and Prior to Owner's Occupancy:</u> If air moving equipment must be used during construction, temporary filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2-2007, and shall be installed at each return air grille, return air register, exhaust grille, exhaust register, and unit return air inlet.
- **5.4.** <u>Sizes:</u> Take measurements at job and fit work into available space. Report to the Architect any unworkable conditions encountered and alter layout or duct sizes as directed without additional cost to the Owner or the Owner's Project Design Professionals. Unless otherwise approved, conform to dimensions indicated. Duct dimensions shown indicate NET FREE AREA after installation of duct liner; increase sizes indicated to allow therefore.
- 5.5. <u>Sheet Metal:</u> ARMCO, or equal, prime quality, G-90 galvanized sheet steel. Unless indicated otherwise on the plans, gauges shall be as recommended in the current edition of current SMACNA "Duct Construction Standards" but in no case shall be less than listed in the table below for the respective duct largest dimension or diameter.

Up to 30 inches	24 ga.
31 to 54 inches	22 ga.
55 to 84 inches	20 ga.
85 to 96 inches	18 ga.

Where galvanized metal joins aluminum or copper, separate sheets with lead or chromate impregnated felt gaskets.

5.6. <u>General Fabrication:</u> Construct and erect in a skillful manner, meeting requirement of the current SMACNA "Duct Construction Standards" for 2" static pressure unless noted or specified otherwise. Where conflicts occur between current SMACNA and the contract drawings or specifications, the most stringent requirements shall

apply and the heaviest gauge metal shall be provided. Form straight and smooth on the inside, with joints neatly finished. Make up in sections of such length that mechanic can reach thru open end to seal insulation at previous joint. Assemble and anchor to be completely free from vibration and drumming under all conditions of operation. Make takeoffs at round ducts with prefabricated round-to-rectangular and rectangular-to-round transitions. Break so that manufacturer's quality stamp is exposed to view.

Where ductwork penetrates partitions above the ceiling, openings shall be size as required for duct and insulation, plus 1". Openings shall be saw cut or properly blocked out and present a neat appearance. Fill void between wall penetration and duct with fire retardant mineral wool insulation, and seal with fire stopping material to prevent the passage of smoke and fire. After closing and filling the annular space, provide 4" wide, 16 gauge galvanized steel closure plates around the penetration, completely covering the opening. Closure plates shall fit snugly to duct and shall be secured to wall.

Provide additional supports to raise ductwork off any piping or as a minimum, provide Rubatex insulation between ductwork and piping. The use of Rubatex insulation between piping and the ductwork shall only be allowed when providing supports is not an option.

- **5.7. Exposed Ductwork:** Install tight against the wall and/or ceiling with drive slip joints. Provide 4" wide, 16 gauge galvanized steel closure plates, except at grilles and registers, where exposed ducts pass through walls and partitions. Fill void between wall penetration and duct with fire retardant mineral wool insulation and seal with fire stopping prior to installing closure plate. Closure plates shall fit snugly to duct and shall be secured to wall. All ductwork and closure plates that are exposed to view in finished areas shall be primed and painted as directed by the Architect. All exposed rectangular ductwork traverse joints shall be made with all metal Ductmate joints system as manufactured by Ductmate Industries, Inc., Quikduc Transverse Duct Connection Systems, Duro Dyne Dyn-O-Mate or approved equivalent. Ductmate system shall be installed in strict accordance with current SMACNA and manufacturer's recommendations and instructions. See spec section "Painting" for additional information.
- 5.8. <u>Cross-Joints, Seams and Stiffening:</u> Join and stiffen with combination of joint types and structural angles as recommended in current SMACNA "Duct Construction Standards". Cross break all flat areas over 18 inches wide. Install internal ends of slip joints in the direction of flow. Non-galvanized pieces must be painted before assembling with Rust-Oleum metal primer. All transverse joints with long dimension over 24" shall be made with all metal Ductmate joints system as manufactured by Ductmate Industries, Inc., Quikduc Transverse Duct Connection Systems or Dyn-O-Mate. System used shall be installed in strict accordance with current SMACNA and manufacturer's recommendations and instructions.

Make all cross joints and all branch, grille and diffuser take-offs, except Ductmate joints, air tight by applying fibrated, low VOC, LEED IEQ 4.1 compliant duct sealer. Sealer shall meet and pass ASTM D-2202, ASTM C-731 and EPA regulations. Sealer shall meet the requirements for the pressure classification of the ductwork installed. Sealer shall be Hardcast Duct Seal 321, Foster 32-17 or Childers CP-148.

5.9. Turns and Transitions: Fabricate turns with an inside radius equal to width of duct. At 90-degree turns, Contractor may substitute square elbows, with standard factory-

made, multiple, double-blade constructed vanes. Vanes shall be a double wall, true airfoil contour with smoothly rounded entry nose with extended trailing edge. Vanes shall be formed from a single piece of 26 ga., hot dipped galvanized steel and shall be 3" radiused vanes on 2.4" centers. Vanes shall be provided with two (2) tie rods and continuous internal tubes for stiffening and rigidity. Maximum pressure drop shall be .06" W.G. at 1500 FPM. Generated sound power level shall not exceed 54 decibels in band 4 at 2000 FPM (24"x24" duct size). Vanes shall be as manufactured by Aero/Dyne Series HEP or approved equivalent by DuctMate. Avoid abrupt changes in shape, with a slope of 4:1 the minimum allowed.

- 5.10. <u>Branch Duct Take-Off:</u> Provide at all points where branch ducts take off from trunks, and where ducts divide. Refer to details on the drawings. Damper shall be minimum 22 Ga., G-90 Galvanized steel with 2" build out. Body shall be a minimum of 24 Ga., G-90, galvanized steel with 4"W.G. construction. Fitting shall have 1" flange with corner clips, pre-punched mounting holes and adhesive coated gasket. Take-off shall be Flexmaster LDS, BO3, GSI HETO (high efficiency take-off) HTS2 or approved equivalent.
- **5.11.** <u>Volume Dampers Used with Automatic Controls:</u> See Controls at end of Section 15700.
- **5.12. Volume Dampers:** For round ducts less than 12" diameter and rectangular ducts less than 12" in height in either dimension: Single leaf, constructed with 18 gauge galvanized metal with locking type control quadrant, single center u-bolt and pivot rod extending through opposite side of duct with brass bushing at both ends.
- **5.13.** <u>Volume Dampers:</u> For round ducts greater than or equal to 12" diameter or rectangular ducts greater than or equal to 12" height in either direction, provide opposed blade, airfoil blades of 16 ga. galvanized steel mounted in steel frames by 3/8" steel trunions riding in brass bushing with dual u-bolts. Blade width shall not exceed 10 inches and individual blade length shall not exceed 48 inches. Extend one trunion to permit operation from outside the duct. Provide manually operated dampers with cadmium plated steel locking quadrant. Dampers opening to the outside shall have felted edges.
- **5.14. Stand-Off Mounting Brackets:** Locking-type quadrant operators for dampers, when installed on ducts to be externally insulated, shall be provided with stand off mounting brackets, bases or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.
- 5.15. <u>Access Doors:</u> Provide in duct wall at each splitter, fire and motorized damper, at each of coil and strip heaters, smoke detectors, in plenums and elsewhere indicated or required for proper maintenance. Size and position to provide maximum access to bearings, fusible links, etc. Typical doors shall be double metal faced, internally insulated same as duct, provided with gasket seal, and with minimum of two-sash locks equivalent to Ruskin Model ADC12 for rectangular ductwork. Access doors for round ductwork shall be similar except with two large hand knobs and equivalent to Ruskin Model ADR1 for round ducts 10" round, up to and including, 16" round duct. Doors shall be rated for the anticipated duct pressure, plus 1". For ducts, 8" round and smaller, provide a removable section of duct to provide required access. Refer to other sections for access doors required in kitchen hood exhaust ducts, moisture-laden ductwork, etc.

- **5.16.** Duct Instrument Test Holes: Provide for each system four test holes (two in supply duct and two in return air plenum) at opposite ends near air handling units with screwed caps. In addition, at duct mounted coils and electric duct heaters provide one on either side of the coil or duct heater.
- **5.17.** <u>Flexible Connections:</u> Connect all ducts to air handling units and fans excepting dome type fans with preassembled flexible connection. Install so that the connector is in folds (not drawn tight). Fabric width shall be 6" for all air handling equipment. Ceiling mounted exhaust fans and VAV terminal units whose total scheduled CFM is less than or equal to 1,200 CFM may be 4" width.

Connectors for all air handling equipment shall be a factory fabricated and assembled unit with 6" dual fabric, heavy duty, 20 oz/sq. yd polyester/polyester fabric with flame resistant coating and mildew resistant per ASTM G-21. The assembly shall comply with NFPA 701, NFPA 90A, NFPA 90B and ASTM E-84. The unit shall be constructed of minimum 24 ga. galvanized steel meeting ASTM A-653-94-G60. Metal to fabric connectors shall be double locked, airtight and waterproof to 10" W.C. positive pressure and 10" W.C. negative pressure. Assembly shall be DuctMate PROflex or equivalent.

Provide copper jumpers across all flexible connectors taking care that jumpers do not bind flexible connections. Provide compression lug and grounding connector screwed into the duct with two (2) screws, on both side of the flexible connector. Bonding wire shall be shielded 4 AWG.

5.18. Register and Grille Connections: Where take-offs are in side of a duct, clinch lock short tee sections onto trunk. Install collars with slip joints and ¾" flange at outlet end. At sheetrock and other hard surfaces, set collars exactly flush with surface (mechanic must be on job to make adjustments during installation). Set flange face to receive register gasket, and be concealed by register flange. Collars may be deleted where mounting frames are furnished with registers.

Install boots above lay-in ceilings simultaneously with ceiling work; mechanic must be on job during this phase of construction work.

At return air, relief air and exhaust air grilles 48" or more in either dimension, collars shall be 1" x 2" x 1/8 inch steel angle frames with corners mitered, welded and ground smooth. Frames in ceiling shall be independently suspended from the ceiling structure, or the duct shall have special reinforcing to prevent sagging of the boot. Interior of ductwork visible through grilles and diffusers shall be painted flat black meeting ASTM E84 25/50 requirements.

5.19. <u>Hangers and Supports:</u> "Sammy" bolts are prohibited. Contractor shall provide supplemental steel between structural purloins, bar joists, etc., for duct support as required to meet support spacing specified. Supplemental steel shall be welded in place as directed by the Structural Engineer. Support small (less than 40 united (w+h) inches) horizontal ducts without external insulation with 1-1/4" x 20 ga. band hangers. Provide in pairs close to each transverse joint and in no case more than six feet apart. Bands shall be turned 3" under the lower corner of ductwork and fastened with two (2) self-tapping screws into the bottom of the duct surface. Bands shall be attached up the sides of the ductwork at a maximum of 6" intervals and in the bottom of the duct. Bands shall pass completely under and around round ducts. All round duct with external insulation shall be provided with band hangers and saddles as specified for flexible duct runouts. Loop top end of hangers over steel structural

members above and fasten with two (2) galvanized bolts. Where concrete joists occur overhead, secure straps to side of joist with galvanized expansion or ramset bolts. Where flat concrete surface occurs overhead, secure with ramset or expansion bolt fasteners. See other Specification Sections in the Contract Documents for limitations on use of powder driven fasteners.

Support small vertical runs with 1/8" steel bands screwed to 3 sides of duct and expansion bolted to adjacent structural elements; spacing shall not exceed 10 feet. Support vertical runs larger than 40 united (w + h) inches with structural brackets with welded joints.

When duct hanger straps distance from top of duct to bottom of structure above exceeds 36", Contractor shall provide unistrut assembly with threaded rods in lieu of duct straps. Provide supplemental steel as required for the proper installation of the unistrut assembly. Wherever duct hanger support rods exceed 36" length from top of the supported item to the structure above, Contractor shall provide a uni-strut support assembly and provide bracing of the assembly with 1"x1"x1/4" angle iron and anchor to structure above to prevent swaying.

Where trapeze type hangers or Ductmate is used to support exposed ductwork in finished areas, the width of the support shall not exceed the duct width by more than six (6) inches on either side of the duct.

5.20. Roof Intake and Relief Hoods: Greenheck Model FGI/FGR or approved equivalent by Loren-Cook, aluminum or galvanized steel construction unit with welded joints, complete with 1/2" aluminum bird screen, rain gutter, weather baffle, 10" high (exhaust/relief) or 14" high (intake) height NRCA approved roof curb (outside air) with built-in cant strip, integral fiberglass insulation and wood nailer. Hood sizes smaller than 24"x24" shall be hinged type. All intakes, relief or exhaust vents greater than or equal to 12x12 shall be 125 MPH rated. Coordinate with architectural and structural plans for required slope. Coordinate roof curb and interface in the building roofing system. Verify minimum net height to be as required by Code and Architect. Maximum intake throat velocity of 250/500 FPM and .05" WC maximum pressure drop. Maximum relief throat velocity of 600 FPM and .05" WC maximum pressure drop. Hood, throat and curb cap shall be minimum 18ga. All items furnished shall adhere to roofing manufacturer's requirements so as not to void the roofing warranty. Hoods shall be factory primed for painting in the field or factory baked enamel finish. Coordinate finish requirement with Architect prior to ordering.

PART 6. REGISTERS, GRILLES AND DIFFUSERS

- 6.1. <u>General:</u> All grilles shall be product of a single manufacturer; shall be constructed of extruded aluminum with baked enamel finish with color as selected by the Architect. Architect may require painting of the grilles, registers, etc., in the field. Where field painting is required, diffusers, grilles and registers shall be factory primed for painting in the field. Refer to Architectural Section "Painting", coordinate requirements and provide finish as required. All grilles and registers shall be ADC or approved equivalent Agency certified.
- 6.2. <u>Wall Supply Air Registers:</u> Titus Model 300 FS-5-D-65, Price 620DAL-F-S-D-A-SW all aluminum adjustable 4-way deflection type. Provide with AG 35B aluminum opposed blade damper with worm gear, Allen Key operators and AG-225 extractors

with No. 1 operator, auxiliary mounting frame and baked enamel finish color selected by the Architect.

- **6.3.** <u>Wall Louvers for Fresh Air Intake:</u> Specified (together with screen) under Division 10 of specifications.
- **6.4. Expanded Metal Grilles:** Provide metal grille equal to McNichols Co., flattened expanded metal, galvanized, hot dipped, 3/4, #16 flattened, minimum 70% open (free) area with U-Edging to protect occupants from injury. Grille shall be factory primed for painting in the field as directed by the Architect.
- 6.5. <u>Equal Products:</u> By Titus, Price, Krueger and Metalaire will be accepted.

PART 7. VENTILATION

- 7.1. General: Provide all fans complete with ducts, grilles, curbs and required accessories. All roof curbs, etc., furnished shall adhere to the roofing manufacturer's requirements so as not to void the roofing warranty. The top of all roof curbs shall be level with pitch built into curb when deck slopes 3/8 of an inch per foot or more. Coordinate with architectural and structural plans for required slope. Coordinate roof curb and interface in the building roofing system and verify minimum net height to be as required by code or as required by Architect. Refer to architectural specification. Furnish sound absorbing curbs required to obtain noise levels specified. See Part "Vibration and Noise Control" for additional requirements. Provide for all fans to be interlocked with air handling units a "hand" - "auto" - "off" switch. All fans shall be AMCA certified in accordance with Standards #210 and 300. Fans wheels shall be balanced in accordance with AMCA Standard 204-05. Fans shall be UL 705 listed and shall bear the UL Label. Furnish for approval capacity and sound power ratings. All motors 1/2 HP and smaller shall have built-in overload protection. All belt driven fans shall have v-belt drive sized for 150% of the installed motor horsepower, adjustable pitch cast iron sleeves for motor and adjustable motor base. All motors shall also be premium efficiency type. Refer to Section Motors for additional requirements. Scheduled static pressures are external to sound curbs
- 7.2. Cabinet In-Line Centrifugal Fans: Loren-Cook Series "SQ" in-line centrifugal type fan as shown on the fans schedule. Fan shall have 18 ga. galvanized steel cabinet with integral duct collars, bolted access doors on 3-sides which are sealed with closed cell neoprene gasketing, disconnect switch, centrifugal, backward inclined extruded aluminum fan wheel and cast aluminum hub, supports for ceiling suspension, permanently lubricated drip proof motor, and gravity type discharge damper. Bearings shall be heavy duty, L50 life in excess of 200,000 hours at maximum cataloged operating speed. Bearings shall be regreaseable ball type with extended fittings in a pillow block cast iron housing. Coordinate fan arrangement required (top, side and bottom) at the site, prior to ordering fan. Where fan is used a supply air fan, Contractor shall provide fan with filter frame and 1" thick metal washable filters if access to filter section requires removal of the fan housing panel. Do not provide Manufacturer provided filter frame unless it is external to the unit and is provided with thumbscrew access. Filter access requiring the removal of the fan housing is prohibited. The Contractor is responsible for guarterly filter cleaning during the guarantee period.
- 7.3. <u>Acceptable Manufacturers:</u> Cook, Acme, Greenheck, PennBarry.

PART 8. GASOLINE/DIESEL FUEL MONITORING SYSTEM

8.1. <u>General:</u> Gasoline Fume Detector shall provide contiuos monitoring of LEL/CO/CO2 and hydrogen sulfide concentrations within the space. The unit shall be self testing, microprocessor-controlled, low profile, water resistant design, monitoring, transformer, plug-in sensors with relay to automatically energize exhaust fan upon detection of fumes above 16% Lower Explosion Level (LEL), sensor cables, lead cables, fault light alarm and 85db output horn. The unit shall detect gasoline and diesel fuel vapors. Unit shall be RKI Instruments Beacon Series 410A controller, or approved equivalent, and required accessories as shown on the plans and required for a complete and functional installation. Unit shall be installed in strict accordance with the Manufacturer's recommendations.

PART 9. AUTOMATIC CONTROLS

- **9.1.** <u>General:</u> Furnish and install a complete system of automatic temperature controls, as specified herein, as shown on the Drawings and as required for a complete installation. All temperature control equipment shall be of the electric type.
- **9.2.** <u>Submittals:</u> The temperature control contractor shall submit 5 copies of complete control diagrams with written "sequence of operation" and factory-printed specification data sheets covering each control device proposed to be used for Engineer's approval prior to installation of any equipment or part of system. Submittal data shall include a schedule of all devices to be installed.
- **9.3.** <u>Installation:</u> By trained and experienced mechanics. All work shall be done by the control sub-contractor.

All wiring incidental to the control system not shown on the Electrical Drawings or specified in Division 16 shall be provided and installed by the Control Contractor including all interlock control wiring between the various components of the air conditioning system, and all smoke detection system electrical wiring. All wiring shall be in accordance with the National Electrical Code, and all State and local codes. All control wiring shall be installed in conduit.

Provide permanent nameplates for all control components and for all motor starters. Nameplates shall be engraved laminated plastic with letters sufficiently large to be legible under normal operating conditions.

9.4. <u>Controls and Instrumentation Cable:</u> Instrumentation cable shall be minimum AWG as recommended by the controls system manufacturer. Cable shall be stranded copper, single or multiple twisted, minimum 2 inch lay of twist, 100 percent shielded pairs and shall have 300 volt insulation. Each pair shall have a tinned copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum polyester or tinned copper cable shield tape, overall AWG as recommended by the controls system manufacturer, tinned copper cable drain wire and overall cable insulation. All wiring and cable shall be in conduit except conduit is not required above lift-out (lay-in) ceilings. Provide independent, minimum 1", aluminum or rust resistant coated steel J-hook supports for all wiring not in conduit. Wiring supports shall be attached to the building structural system (not other trades' supports, piping, duct, ceiling suspension system, etc). Wiring, cabling, etc., shall be neatly bundled together and supported at no more than six (6) feet on center. All

wiring, cabling, etc., shall be plenum rated and rated for use at temperatures expected in the location of mounting.

- **9.5.** <u>Fume Monitoring System</u>: Coordinate all requirements with the Mechanical Contractor and Fuel Monitoring System provide as required for complete and functional installation as required
- **9.6.** <u>Motorized Dampers:</u> Equal to Ruskin Series CD-40 with heavy duty Belimo actuator. Provide weatherproof construction for outdoor installation.
- **9.7.** <u>Space Thermostats:</u> Space thermostats shall be 7-day microprocessor programmable, low voltage with "Summer-Winter" and fan On-Off-Auto switches subbase. Coordinate thermostat options and provide as required to accomplish specified sequence of operation. Each thermostat shall have building power supply with transformer and battery back-up power. Provide hinged metal guard with rounded corners, lock and key for each thermostat. All thermostat boxes shall be mounted 46" A.F.F. to the center of the box (ADA height).
- **9.8.** <u>Service and Guarantee:</u> After completion of the installation, adjust all control equipment and place the complete system in operation subject to the approval of the Engineer. Guarantee the control system to be free of defects and adequate to provide required control functions for a period of one year after acceptance of project. Provide free service and maintenance during the guarantee period.
- **9.9.** <u>Exhaust Fan Controls:</u> Where indicated provide room thermostats to control the respective fan and intake damper operation to maintain space temperature. Also, provide interlock wiring from each exhaust fan to the respective motorized damper motor to operate damper anytime fan is started. Refer to gasoline fume monitoring system specification and coordinate requirements. Refer to plans for sequence.
- **9.10.** <u>Miscellaneous Control:</u> Provide other miscellaneous controls as required for a complete functional control system.

END OF SECTION

Division 16



Prepared by Kenneth R. Gunn Jr., P.E.

SECTION 16100 ELECTRICAL

PART 1 - GENERAL

1.01. RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work specified in this section.

1.02. QUALIFICATIONS OF ELECTRICAL CONTRACTORS:

A. Electrical contractor must be properly established as an electrical contractor by the State of Alabama. Electrical contractor shall have had previous experience in the satisfactory installation of at least three systems of this type and size in the State of Alabama.

1.03. CODES, PERMITS AND INSPECTIONS:

- A. Comply with applicable laws of the community, with latest edition of National Electrical Code (NEC), NFC 70, and the International Building Code(IBCC) or the edition adopted by the local authority having jurisdiction, where not in conflict with those laws, and with the service rules of the local utility company.
- B. Obtain and pay for all permits and deposits, and arrange for inspections as required.
- C. After completion of the work, submit certificate of final inspection and approval from the local electrical inspector, certifying that the installation complies with all regulations governing same.

1.04. MATERIALS:

- A. All materials shall be new, and UL approved where a standard has been established.
- B. Manufacturers' names and model numbers shown on the plans and in the specifications are given to indicate the type and general quality of items to be provided. Equal products by other manufacturers will be accepted.
- C. Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect/Engineer has been presented in writing, with samples if requested by the Architect/Engineer. All prior approvals must have the approval of the engineer of record at the offices of Gunn and Associates, P.C. located at 3102 Highway 14, Millbrook, AL 36054, Phone: 334-285-1273, Fax: 334-285-1274
- D. All proposed substitutions shall be approved in writing at least ten (10) days prior to the bid date.
- E. It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

1.05. WORKMANSHIP:

A. Execute all work so as to present a neat and workmanlike appearance when completed.

1.06. DESCRIPTION OF WORK:

- A. Furnish all labor and materials required to complete the electrical work indicated on the drawings or herein specified. Major work included in Section 16 shall be:
- B. Arrange with the local utility companies for providing such electrical services as indicated on drawings or herein specified. Any charges for electrical service to the facility by the utility company shall be included in the contractor's bid price.
- C. Remove or relocate all electrical or electronic services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the complete project or any code pertaining thereto.

- D. Furnish and install a complete power system including but not limited to the connection of all meters, panelboards, circuit breakers, power outlets, convenience outlets, lighting fixtures, switches, and/or other equipment forming part of the electrical system.
- E. Connect all electrical equipment whether furnished by this contractor or by others.
- F. Furnish and install all disconnect switches not included as an integral part of equipment.
- G. Complete the alterations, additions, and renovations to the electrical system in the existing building as specified herein or as shown on the drawings.
- H. Procure and pay for permits and certifications as required by local and state ordinances and certificate of inspection.
- I. Visit the site and determine conditions that affect this contract. Failure to do so will in no way relieve the Contractor of his responsibility under his contract.
- J. Submit to the Architect a certificate of final inspection from local and/or state inspection authorities.
- K. Establish and maintain temporary electrical services for construction purposes.

1.07. DRAWINGS AND SPECIFICATIONS:

- A. This Contractor shall examine drawings and Specifications relating to the work of all trades and become fully informed as to the extent and character of work required and its relation to all other work in the project prior to submission of bid and prior to the start of any construction.
- B. Drawings and Specifications shall be considered as complementary each to the other. What is called for by one shall be as binding as if called for by both. Where conflicts occur, secure clarification from the Architect in advance of bidding; otherwise incorporate the more stringent conditions into the bid price.
- C. Omissions from the drawings and specifications or the mis-description of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work; they shall be performed as if fully and correctly set forth and described in the drawings and specifications
- D. The drawings indicate diagrammatically the extent, general character, and the approximate location of the work to be performed. In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, locations of conduit, fixtures, outlets, and equipment with the detailed architectural, structural, and mechanical drawings, and lay out work so as to fit in with ceiling grids, ductwork, sprinkler piping and heads, and other parts. Take finished dimensions at the job site in preference to using scale dimensions.
- E. Where the work is indicated but with minor details omitted, furnish and install the work complete so as to perform its intended functions.
- F. Where doubt arises as to the meaning of the plans and specifications, obtain the Architect's decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.
- G. Except as noted above, make no changes in or deviations from the work as shown or specified except on written order of the Architect.

1.08. EXISTING CONDITIONS:

- A. Before submitting a bid, visit the site and ascertain all existing conditions.
- B. Make such adjustments in work as are required by the actual conditions encountered.
- C. No consideration will be given after bid opening for alleged misunderstandings regarding utility connections, integration of work with existing system, or other existing conditions.

1.09. SUBMITTALS:

- A. Follow procedure outlined in Division 1.
- B. Submittals shall be bound together and shall include a coversheet indicating the following:
 - 1. Project name
 - 2. Trade contractor's name

- 3. Supplier's name
- 4. Name and phone number of supplier's contact person
- 5. A list of each item submitted with manufacturers' names and model numbers.
- Within 20 days of award of contract and prior to beginning any work on the project submit six
 (6) copies of manufacturer's drawings/data sheets for the following items to the Engineer for review:
 - 1. Conductors
 - 2. Wiring Devices
 - 3. Conduit Wrapping Tape
 - 4. Panelboards
 - 5. Contractor shall coordinate with mechanical/plumbing shop drawings prior to submitting power package to engineer. Adjust overcurrent devices and feeder sizes accordingley.
 - 6. Disconnect Switches
 - 7. Fire Stopping
 - 8. Transient Voltage Surge Suppressors(Surge Protective Devices)
 - 9. Fire Alarm System:
- D. Submit samples upon request.
- E. The Contractor is responsible for verifying all quantities and for verifying and coordinating dimensional data with the available space for items other than the basis of design.
- F. The contractor shall review and approve, or make appropriate notations on each item prior to submittal to the architect. Submittals without contractor's approval will be rejected.

1.10. COORDINATION OF SERVICE WITH OTHER TRADES:

- A. It shall be the responsibility of the Electrical Contractor to coordinate the electrical service characteristics to each piece of electrically operated equipment with all trades providing electrically operated equipment.
- B. Within ten (10) working days of notification to proceed with construction from the Architect, the Electrical Contractor shall notify, in writing, all trades providing electrically operated equipment the characteristic of the electrical power being supplied to each piece of electrically operated equipment.
- C. A copy of this notification shall be provided to the General Contractor and the Architect.
- D. Be informed as to equipment being furnished by other trades, but not liable for added cost incurred by equipment substitutions made by others which require excess electrical wiring or equipment above that indicated on drawings or specified.
- E. The contractor providing the equipment shall be responsible for the additional costs.

1.11. PROGRESS OF WORK:

A. Schedule work as necessary to cooperate with other trades, Do not delay other trades. Maintain necessary competent mechanics and supervision to provide an orderly progression of the work.

1.12. PROTECTION OF PERSONS AND PROPERTY DURING CONSTRUCTION:

- A. Take all precautions necessary to provide safety and protection to persons and the protection of materials and property.
- B. Protect items of equipment from stains, corrosion, scratches, and any other damage or dirt, whether in storage, at job site or installed. No damaged or dirty equipment, lenses, or reflectors will be accepted.
- C. Live panelboards, outlets, switches, motor control equipment, junction boxes, etc., shall be protected against contact of live parts and conductors by personnel.

1.13. CLEANING UP:

A. During the progress of work, keep the Owner's premised in a neat and orderly condition, free from accumulation of debris resulting from this work. At the completion of the work, remove all material, scrap, etc. not a part of this Contract.

1.14. AS-BUILT DRAWINGS, AND OPERATING AND MAINTENANCE INSTRUCTIONS:

17-189 (Mechanical & Electrical Improvements Lawerence County BOE) Section 16100-3 GA#17-131

- A. Prior to the Final Acceptance Inspection the Contractor shall turn over to the Architect one set of reproducible "as built" drawings, including corrected fire alarm system shop drawings, three (3) sets of all equipment catalogs and maintenance data, manufacturers' warranties, and three (2) sets of all equipment catalogs and maintenance data.
 - (3) sets of shop drawings on all equipment.

1.15. TESTING:

A. Upon completion of the work, conduct a thorough test in the presence of Architect or his representative, and demonstrate that all systems are in perfect working condition.

1.16. INSPECTIONS:

A. The contractor shall have all systems ready for operation and an electrician available to remove panel fronts, coverplates, fixture doors, etc., at the final inspection and any other scheduled inspections.

1.17. DEMONSTRATION:

A. By on-off, stop-start operation, demonstrate to the Owner or his representative, the use, working, resetting, and adjusting of each and every system. Submit statement initialed by the Owner that such demonstration has been made.

1.18. WARRANTY:

A. Warrant the entire electrical system in proper working order. Replace, without additional charge, all work or material that may develop defects (ordinary wear and tear or damage resulting from improper handling excepted) within a period of one year from date of final to general contractor. Provide the owner with two bound copies of all manufacturers' warranties.

1.19. TEMPORARY SYSTEMS:

- A. The Electrical Contractor shall be responsible for furnishing and installing equipment and materials necessary for providing electrical power and lighting where needed for the construction of the project.
- B. Electrical Contractor will be responsible for paying for and providing temporary construction power and lighting for entire job site. Coordinate with local jurisdictions and utility companies and pay all fees necessary to get temporary power to the job site. General Contractor shall be responsible for all monthly utility cost for duration of project or date of substantial completion.

1.20. SERVICE INTERRUPTION CLEARANCE WITH OWNER:

A. Before submitting a proposal, check with the Owner concerning interruption of service to the existing electrical systems. No interruption shall be made except at such time and for such duration as approved by the Owner. The Contractor's bid shall include all necessary over-time and weekend work.

1.21. DEFINITIONS:

"AWG" - American Wire Gauge

"ADA" – Americans with Disabilities Act

"As required" - Any and all items required to complete the installation of an item so as to perform its intended function.

"Circuiting" - Conductors, raceways, raceway fittings, and associated hardware.

"EMT" – Electrical Metallic Tubing, "thin wall"

"IBC" - International Building Code

- "Install" furnish, install, and make all necessary connections to and/or for the item(s) indicated or specified.
- "NEC" National Electrical Code, ANSI/NFPA 70, latest edition or the edition adopted by the authority having jurisdiction.
- "Necessary" Any and all items required to complete the installation of an item so as to perform its intended function.

"NEMA"- National Electrical Manufacturers' Association

"NFPA" - National Fire Protection Association

"PVC Conduit" – Rigid Nonmetallic Polyvinyl Chloride conduit

"RGS Conduit" - Rigid galvanized steel conduit

17-189 (Mechanical & Electrical Improvements Lawerence County BOE) Section 16100-4 GA#17-131

PART 2 - MATERIALS

2.01. GENERAL:

- A. This section includes all basic materials for raceways, fittings, busways, conductors, panelboards, switchboards, lighting fixtures and accessories, etc., as required for a complete installation.
- B. All materials shall be new and listed by the Underwriters Laboratories. Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect has been presented in writing, with samples if requested by the Architect.
- C. It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

2.02. CONDUITS:

- A. Rigid Metal (Galvanized Steel-RGS) Conduit: Rigid metal conduit shall be mild steel piping, galvanized inside and outside, and conform to ASA Specification 080.1 and Underwriters' Laboratories Specifications. By Sprang, Republic, Wheatland, Triangle or Pittsburgh.
- B. Intermediate Metal Conduit (IMC): IMC shall be hot dipped galvanized inside and outside and manufactured in accordance with U.L. Standard #6 or #1242. By Allied or approved equal.
- C. Electrical Metallic Tubing (EMT): EMT shall be high grade steel electro-galvanized outside and lacquer or enamel coating inside and conform to ASA Specifications 080.1 and Underwriters' Laboratories Specifications. By Sprang, Republic, Wheatland, Triangle or Pittsburgh.
- D. Rigid Nonmetallic Conduit (PVC): PVC conduit where exposed shall be high impact Schedule 80; below grand and below or in slab PVC shall be of high impact Schedule 40 PVC and shall conform to Underwriters' Laboratories Standard UL-651. By Carlon, Kraley Pittsburgh, R.G. Sloan or Southwestern.

2.03. COUPLINGS, FITTINGS, AND CONNECTORS:

- A. RGS & IMC: By Appleton, Crouse-Hinds, Efcor, O-Z/Gedney, Raco, or Republic.
- B. EMT: EMT fittings shall be all steel type setscrew or insulated throat compression type. Pressure indented or slip fit type will not be accepted. All connectors to be insulated. By Appleton, Efcor, Raco Steel City, or Thomas & Betts.
- C. PVC: PVC fittings shall be of high impact PVC Schedule 40 or Schedule 80 to match the installed conduit. Joints shall be made with PVC solvent cement as recommended by manufacturer. By Pittsburgh, R.G. Sloan or Carlon.

2.04. CONDUIT BODIES:

- A. Conduit bodies shall be shall be malleable iron except in kitchen, dishwashing, and waste water treatment areas conduit bodies shall be copper free cast aluminum with stamped aluminum covers.
- B. Covers shall be screw retained with wedge nut or threaded body. Covers on bodies installed outdoors shall be approved and rated for installation outdoors.
- C. Bodies shall comply with NEC 370 and 373.
- D. RGS & IMC: By Appleton, Crouse-Hinds, Efcor, O-Z/Gedney, Raco, or Republic.
- E. Conduit cannot be used as ground. Provide separate insulated green grounding wire.

2.05. BUSHINGS:

- A. Bushings up to and including 1" shall have a tapered throat.
- B. Bushings 1-1/4" and larger shall be the insulating type.
- C. Grounding bushings shall be specification grade insulated grounding type bushings with tin plated copper grounding saddles and shall be equal to O-Z/Gedney Type BLG or HBLG.

17-189 (Mechanical & Electrical Improvements Lawerence County BOE) Section 16100-5 GA#17-131
- D. Bushings shall be zinc plated malleable iron or copper free cast aluminum.
- E. Bushings for terminating Data, Telecommunications, control, CATV, and similar conduits above ceilings and at backboards may be PVC or Polyethylene insulating bushings equal to those manufactured by Arlington Industries and Bridgeport Fittings.

2.06. EXPANSION FITTINGS:

- A. Conduit Expansion Joints shall be UL Listed.
- B. Expansion joints in rigid metal conduits shall consist of a threaded malleable iron body, pressure bushing, watertight packing, pressure ring, gasket, insulating bushing, and external grounding jumper, and shall be equal to O-Z Gedney Type AX with Type BJ bonding jumper.
- C. Expansion joints for EMT conduit shall be same as above with additional EMT couplings and connectors, and shall be equal to O-Z Gedney Type TX with Type BJ bonding jumper.
- D. Expansion joints in PVC conduit shall be equal to Carlon Series E945.
- E. Expansion joints shall provide a minimum of 4" of conduit movement.

2.07. BELOW GRADE THRU WALL WATER SEALS:

- A. Thru wall water seals for conduits penetrating exterior below grade concrete walls shall be seal systems by O-Z/Gedney or The Metraflex Company.
- B. Thru wall water seals for conduits penetrating exterior below grade concrete walls shall be Metraseal thru wall water seals by The Metraflex Company.

2.08. CONDUIT ACCESSORIES:

- A. Conduit clamps and supports for metallic conduit shall be galvanized steel by Efcor, Steel City, or Mineralac. Conduit fittings by Appleton, Crouse-Hinds, O-Z/Gedney, Pyle-National or approved equal.
- B. Conduit clamps and supports for nonmetallic conduit shall be nonmetallic high impact PVC by Carlon, Pittsburg, or Sloan.
- C. Conduit clamps for aluminum conduits shall be stainless steel or cast copper free aluminum with stainless steel fasteners.

2.09. FLEXIBLE CONDUIT:

- A. Liqudtight flexible metal conduit:
 - 1. Neoprene-jacketed liquidtight flexible metal conduit.
 - 2. Equal to Anaconda Sealtite.

2.10. ELECTRICAL TAPES:

- A. General use electrical tape shall be 8 mil (.008") thick, minimum, premium grade, pressure sensitive, flame retardant, vinyl electrical tape meeting UL 510, ASTM-D-3005, and MIL-I-24391C. The tape shall be equal to 3M No. 88 or Plymouth Premium 85 CW.
- B. Rubber tape used as primary tape shall be a 30 mil (.030") thick, minimum self-amalgamating, low voltage rubber tape rated for use through 600 V. Rubber tape shall be equal to 3M No. 2150 or Plymouth 122 Rubber Tape.
- C. Electrical filler tape shall be a 125 mil (.125") thick, minimum, self-amalgamating, low voltage insulating compound rated for use through 5 kV. Filler tape shall be equal to 3M SCOTCHFILL or Plymouth 125 Electrical Filler Tape.

2.11. PIPE WRAPPING TAPE:

- A. Pipe wrapping tape shall be a 10 mil (.010") thick, minimum, pressure sensitive, vinyl tape manufactured for pipe wrapping applications.
- B. The tape shall be UV, bacteria, and fungus resistant.
- C. The manufacturer's name and tape type shall be printed on the back of the tape.
- D. Pipe wrapping tape shall be equal to Plymouth Rubber Co. PLYWRAP 11, or 3M No. 50.

2.12. WIRE NUTS:

- A. Wire nuts for conductor splicing shall be winged type connectors with a square, plated steel spring and flame retardant thermoplastic shell.
- B. The connector shall be rated for the number and size conductors being connected.
- C. The Wire Nuts shall be rated for 105° C. And UL 486C listed.
- D. Wire nuts shall be equal to connectors by Ideal/Buchanan, 3M/Scotch, or T & B,

2.13. SPLIT BOLT CONNECTORS:

- A. Split bolt connectors for splicing conductors shall be UL 486A listed, shall be tin plated copper, and shall have a hexagonal head and nut.
- B. Split bolt connectors for conductors size AWG #4 and larger shall have a serrated spacer bar between conductors.
- C. Split bolt connectors for splicing conductors AWG #12 through #6 shall be equal to IIsco Type SEL and Type SK for AWG #4 and larger conductors.

2.14. MULTI-TAP CONNECTORS:

- A. Multi-tap connectors shall be insulated type
- B. Multi-tap connectors shall be rated for the conductor sizes indicated on the drawings.
- C. The connectors shall be provided for the number of conductors indicated, including any future taps shown, plus a minimum of one additional tap.
- D. Multi-tap connectors shall be equal to IIsco Type PCT or Type PED-CP.

2.15. WATERPROOF WIRE JOINTS:

- A. Splices made below grade shall be made connectors, UL listed as waterproof, for below grade applications.
- B. Waterproof Twist On Connectors for Up to2#6 W/1#12 tap Conductors: Single piece wire nut pre-filled with silicone sealant. Sealant shall be rated for 45-400 degrees F. Connectors shall have same insulation rating as conductors. Sizes shall be available for connecting up to 2 #6 w1#12 tap conductors. Connectors shall be UL listed as waterproof for below grade applications and equal to Ideal Buchannan B-Cap Twist and Seal Wire Connectors, King Safety Products, Tyco/Raychem GelCap SL, or equal.
- C. Waterproof Stub Splice Kit for up to #2/0 Conductors: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit shall be rated for feeder wire sizes #14 through #2/0 and tap wire sizes of #14 through #6. Connectors shall be UL listed as waterproof for below grade applications and equal to Tyco/Raychem GelCap SL.
- D. Waterproof In-line Splice Kit for up to #2/0 Conductors: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit shall be rated for wire sizes #6 through #350 kcm. Connectors shall be equal to Tyco/Raychem GTAP.
- E. Waterproof Splice Kit for Conductors above #2/0: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit shall be rated for wire sizes #14 through #2/0. Connectors shall be equal to Tyco/Raychem GHFC.

2.16. PLASTIC MARKING TAPE FOR MARKING UNDERGROUND CABLES AND CONDUITS:

- A. Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch.
- B. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise.
- C. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep.
- D. The tape shall be of a type specifically manufactured for marking and locating underground utilities.

- E. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion.
- F. Tape color shall be as specified in the table below and shall bear a continuous printed inscription describing the specific utility.

Red: Electric

Orange: Data, Telephone, Television,

2.17. FIRE STOPPING:

- A. Fire sealant shall be intumescent caulk, putty, sheet and/or wrap/strip as required to attain the proper rating.
- B. Caulk shall be equal to 3M CP25 N/S and/or S/L.
- C. Putty shall be equal to 3M Fire Barrier Moldable Putty.
- D. Sheet equal to 3M CS195.
- E. Wrap/strip equal to 3M FS195.
- F. Equal products by Dow Corning, Hilti, and Metacaulk will be accepted.

2.18. JUNCTION BOXES (THRU 4-11/16"):

- A. Sheet Metal: To be standard type with knockouts made of hot dipped galvanized steel, By Steel City, Raco, Appleton or approved equal.
- B. Cast: To be type FS, FD, JB, GS or SEH as required for application.

2.19. JUNCTION AND PULL BOXES (LARGER THAN 4-11/16"):

A. Shall be cast metal for all below grade exterior use and where indicated on plans. All other shall be oil tight, JIC boxes not less than 16 gauge, equal to Hoffman type "CH" boxes.

2.20. PULL BOXES:

A. Galvanized sheet metal screw-cover type with UL label as produced by Austin, B & C Metal Stamping Company, E-Box, Hoffman, Wiegmann, or approved equal.

2.21. JUNCTION AND TERMINAL BOXES FOR AUXILIARY SYSTEMS:

- A. Junction boxes for auxiliary system circuiting splicing shall be formed of galvanized steel.
- B. Boxes shall have hinged front, locking door(s).
- C. Metal back plates shall be provided for mounting terminal strips or other devices.
- D. Screw terminal strips shall be provided with a minimum of 25 percent spare terminals.
- E. Boxes shall be sized to accommodate the terminal blocks and conductors, providing code required bending space.
- F. Boxes for auxiliary systems shall be manufactured by Austin, E-Box, Hoffman, or Wiegmann.

2.22. AUXILIARY GUTTERS (WIRING TROUGHS):

- A. Gutters shall be of sizes shown and/or required by the NEC (whichever is larger), constructed of code gauge, galvanized sheet steel, painted ANSI 61 gray.
- B. Gutters shall be UL listed and shall be of NEMA 3R construction in wet or damp locations or shall be as indicated on the drawings.
- C. Gutters shall be as produced by Austin, B & C Metal Stamping Company, E-Box, Hoffman, Wiegmann, or approved equal.

2.23. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:

- A. Strut shall be 1-5/8" except where heavier strut is required to support the load, for rigidity, or where specifically indicated otherwise.
- B. Cold-formed steel, ASTM A 570 or A 446 GR A.
- C. Stainless Steel Strut: Type 304, ASTM A 240.
- D. Hot Dipped Galvanized Steel Strut: Zinc coated after manufacturing operations are complete, ASTM A 123 or A 153

- E. Electro-galvanized Steel Strut: Electrolytically zinc coated, ASTM B 633 Type III SC 1.
- F. Fittings: Same material as strut, ASTM A 575, A 576, A 36, A 635, or A 240.
- G. Zinc Primer: As recommended by strut manufacturer.
- H. Strut Systems shall be as manufactured by B-Line, Erico, Globe, Kindorf, MasterStrut, Power Strut, T&B SuperStrut, or Unistrut.

2.24. OUTLET BOXES:

- A. General: Except as noted, boxes shall be standard hot dipped galvanized steel at least 1-1/2" deep, of metal at least 1/16" thick; sized to accommodate devices and conductors per NEC Article 370; product of Appleton, National, Steel City, or approved equal.
- B. Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.
- C. Typical boxes (for switches, receptacles and auxiliary systems):
 - 1. 4" square boxes ganged as required. Box volume shall be in accordance with NEC Section 370 provide extensions as required.
 - 2. Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.
 - 3. Use 4-11/16" square, 2-1/8" deep boxes where more than 10 conductors enter the boxes. Provide extensions as required to provide volume per NEC.
- D. Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover.
- E. Boxes used with Exposed Conduit: 4" square utility boxes.
- F. Exterior Boxes: Galvanized cast-metal boxes, Crouse-Hinds Type FS or FD as appropriate. Make weatherproof with gasketed covers. Equal products by Appleton, Killark, O-Z/Gedney, or approved equal will be accepted.

2.25. CONDUCTORS AND CABLES:

- A. Power Conductors
 - 1. All conductors shall be copper with not less than 98% conductivity and with current carrying capacities per N.E.C. for 60°C. for sizes through #1 AWG and 75°C for conductors #1/0 and above.
 - 2. All conductors shall have manufacturer's name, type insulation, and conductor size imprinted on jacket at regular intervals.
 - 3. Conductors of size #10 and smaller shall be solid copper conductors with 600 volt type THHN or THWN insulation.
 - 4. Conductors of size #8 and larger shall be stranded copper conductors with 600 volt type THHN or THWN insulation.
 - 5. All motor branch circuits, HVAC, and plumbing equipment shall be stranded copper conductors with 600 volt type RHH-RHW insulation.
 - 6. All conductors installed in conduit below grade shall be rated for wet location.
 - 7. Manufacturer: Conductors shall be products of GE, Triangle, Phelps- Dodge, Anaconda, Rome, Habirshaw, General Cable, or approved equal.
 - 8. Fixture Wire:
 - a. Conductors feeding into fixtures, other than fluorescent fixtures, of 300 watts or less shall be #14, 200°C., type SF-2, for fixtures of more than 300 watts #12, 200 °C., type SF-2 shall be used.
 - b. Conductors pulled through fluorescent fixtures shall have Type TFN or TFFN fixture wire, rated 90oC.
 - c. Conductors shall be by Dodge, Anaconda, Rome General Cable or Southwire.
- B. Control and Signal Wire: Conductor type TFF, minimum size #16 copper and fully color-coded, shall be used. Conductors shall be by Anaconda, Houston Wire & Cable, General Cable, Phelps Dodge, Rome, or Southwire.

2.26. WIRING DEVICES:

- A. General: Manufacturer's and catalog numbers listed are used to establish style, type and quality. Unless otherwise indicated on drawings, all wiring devices shall be UL listed, side-wired specification grade.
- B. Manufacturers: Equal devices by Hubbell, Leviton, and P & S will be accepted. All devices shall have plaster ears.
- C. Duplex receptacles (general purpose): 125V/20A flush duplex back and side wired hard use specification grade receptacles, NEMA 5-20R configuration, with nylon face and body, grounding terminal and break-off fins for converting to 2-circuit use. Receptacles shall meet Federal Specification WC-596. Color to match wall switches. Equal to P & S 5362, Hubbell CR20, or Leviton 5362.
- D. Ground Fault Circuit Interrupt Receptacles: 125V/20 amp ground fault circuit interrupting receptacle for personnel protection, NEMA 5-20R configuration, Equal to Hubbell #GF5362, Leviton #6599, or P & S 2091. Each GFCI symbol on drawing indicates a GFCI type receptacle. Do not through-wire non-GFCI receptacles from GFCI receptacles where ground fault protection is required. All exterior receptacles shall be ground fault interrupting type with weatherproof coverplates.
- E. Wiring devices shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and gray.

2.27. DEVICE PLATES:

- A. Type appropriate for the associated wiring device, equal to Sierra Stainless Steel Smoothline. Device plates shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and stainless steel. Provide single plate of proper gang where more than one device occurs (do not gang dimmers with rocker switches).
- B. Damp Location: 20 amp,125 and 250 volt receptacles Covers shall be weatherproof when plugs are not installed, provide cast aluminum weatherproof coverplates with single lift cover and gasket equal to Hubbell CWP26H.
- C. Wet Locations, 20 amp, 125 and 250 volt receptacles: Covers shall be weatherproof In-Use covers, rated NEMA 3R when in use and shall be constructed of cast aluminum with sealing gasket. Covers shall be equal to products by Hubbell, Leviton, Steel City, T & B, and Taymac.
- D. Wet Locations, 20 amp, 125 and 250 volt receptacles: Covers shall be weatherproof In-Use covers, rated NEMA 3R when in use and shall be constructed of impact resistant polycarbonate with sealing gasket. Covers shall be equal to products by Hubbell, Leviton, Steel City, T & B, and Taymac.
- E. Coverplates for exposed cast aluminum boxes in kitchen and dishwashing areas shall be cast coverplates, without lift cover, unless specifically indicated otherwise on the drawings.
- F. Color: Wiring device cover plates shall be of color as indicated on drawings or directed by Architect. Devices must be available in ivory, brown, black, white, gray, and stainless steel.
- G. Jumbo and Mini-Jumbo plates will not be accepted.

2.28. GROUNDING:

- A. Ground Rods shall be $\frac{3}{4}$ " x 10' copperciad steel.
- B. All grounding conductors shall be copper.

2.29. PANELBOARDS:

- A. General: All panelboards shall be dead front type manufactured and installed in accordance with UL and NEMA standards, and shall carry a UL label. Ampacity, service voltage, and configuration shall be as indicated on drawings. Panelboards shall be clearly marked with ampacity, voltage, and maximum short current ratings.
- B. Manufacturer: Panelboards shall be as manufactured by Cutler-Hammer, GE, or Square "D".
- C. Enclosure:
 - 1. Panelboard enclosures shall be as indicated on drawings.

- 2. Unless otherwise indicated, all boxes shall be constructed of galvanized (or equivalent rust-resistant) sheet steel with hinged front trim.
- 3. Fronts shall include door with concealed hinges, lock, and latch. All panelboard locks shall be keyed alike.
- 4. Fronts shall be finished with gray baked enamel over a rust-inhibiting phosphatized coating.
- D. Buss Assembly:
 - 1. Bussing shall be copper.
 - 2. The buss assembly A.I.C. shall be rated as indicated on drawings. Ratings shall be established by heat rise tests, in accordance with UL Standard 67.
 - 3. All bussing shall accept bolt on circuit breakers.
 - 4. Current carrying parts of all bussing shall be plated. In lighting and receptacle panels, bussing shall be designed for connection to the branch circuit breakers in the phase sequence format. Distribution panelboards shall be fully bussed.
 - 5. Ground bars shall be provided in all panelboards.
 - 6. Neutral bar shall be fully sized with lugs suitable for incoming and outgoing conductors.
 - 7. Provide insulated ground buss where indicated on the panelboard schedules.
- E. Circuit Breakers:
 - 1. Circuit breakers shall be quick-make, quick-break, thermal magnetic, molded case, bolt on type.
 - 2. Circuit Breakers shall be numbered and arranged as indicated on the panelboard schedules and/or single line wiring diagrams. Numbers shall be permanently attached to trim.
 - 3. SWD Circuit Breakers: Single pole circuit breakers rated 15 and 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be UL rated for switching duty and shall be marked "SWD".
 - 4. HACR Circuit Breakers: Circuit breakers 60 amperes or below, 240 volts, 1-, 2-, or 3-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be UL listed as HACR type and shall be marked "Listed HACR Type."
 - 5. Circuit breakers serving fire alarm systems, dedicated emergency/exit lighting circuits, and area of rescue communications systems shall be equipped with a screw-on, mechanical handle blocking device which locks the circuit breaker in the "ON" position.
 - 6. Circuit breakers serving circuits in residential bedrooms shall be Arc Fault Interrupting(AFI) type circuit breakers and shall be UL 1699 listed.
- F. Directories:
 - 1. Each panelboard shall be equipped with a metal directory frame with a clear cover welded to the inside of the door.
- G. Equipment Short Circuit Rating: Short Circuit Interrupting Ratings shall be as indicated on the plans and schedules. Unless specifically indicated otherwise all rating are "Fully Rated" capacities. Where no rating is given, the contractor shall verify the available short current with the serving utility and provide equipment rated accordingly.
- H. Lighting panelboard cans shall be a maximum of 20" wide and 5 3/4" deep. Cans of multi-section panelboards shall be the same size.
- I. Provide nameplate as called out on drawings.

2.30. DISTRIBUTION PANELBOARDS:

- A. Furnish and install distribution and power panelboards as indicated in the panelboard schedule(s) or single line wiring diagrams and where shown on the plans.
- B. Panelboards shall be dead front, safety type equipped with thermal magnetic, molded case circuit breakers with trip ratings as indicated on the schedule(s).
- C. Panelboard bussing shall be copper.

- D. Panelboard buss structure and main lugs or main breaker(s) shall have the fault current ratings as indicated on the drawings. Ratings shall be established by heat rise tests conducted according to UL Standard UL67.
- E. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other.
- F. An engraved phenolic label shall be permanently attached to the front of the panelboard adjacent to each circuit breaker identifying the load served by the circuit breaker.
- G. Automatic tripping shall be clearly shown by the breaker handle taking a position between ON and OFF when the breaker is automatically tripped.
- H. Provisions for additional breakers shall be such that no additional connectors or hardware will be required to add breakers.
- I. The panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel shall be as specified in UL Standards. End walls shall be removable. The size of wiring gutters shall be in accordance with the National Electrical Code, NEMA, and UL Standards for panelboards.
- J. Cabinets shall be equipped with four piece fronts.
- K. The panelboard interior assembly shall be dead front with panelboard front removed.
- L. Main lugs or main breaker shall be barriered on live sides.
- M. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the buss structure opposite the mains shall be barriered.
- N. Circuit breakers serving Fire Alarm Systems, Security Systems, and/or Emergency/Exit lights shall be equipped with mechanical, screw-on type, locking devices. These devices shall not be padlock type devices.
- O. Panelboards shall be listed by Underwriters' Laboratories and to bear UL label. Panelboards shall be rated for use as Service Entrance Equipment where required by the National Electrical Code. Panelboards shall be by Cutler-Hammer, General Electric, or Square D.
- P. Provide nameplate as called out on drawings.

2.31. SAFETY SWITCHES:

- A. Furnish and install safety switches as indicated on the drawings.
- B. Switches installed on 277/480 volts systems shall be rated for 600 volts and those installed on 120/208 volt or 120/240 volt systems shall be rated for 240 volts.
- C. Switches shall be NEMA Heavy Duty Type HD and Underwriters' Laboratory listed. Safety switches shall be Cutler Hammer, Square D, or General Electric.
- D. Enclosures for switches mounted outdoors shall be NEMA 3R or as indicated on the plans.
- E. Enclosures for switches installed in kitchen and dishwashing areas shall be NEMA 4X stainless steel or as indicated on the plans.
- F. All safety switches for equipment with remote controls shall be equipped with a control circuit disconnect interlock.
- G. Switches shall be lockable in the "ON" and in the "OFF" positions.
- H. Provide each disconnect with a nameplate that indicates equipment name, voltage/phase, and feed from location.
- I. Provide keyed brass locks on all disconnects that is located on the exterior of the building or in any area that is accessible to children or the public. All the brass locks shall be keyed the same, and turn over 10 sets of keys to the owner at substantial completion.
- J. Disconnect locations shown on drawings is diagrammatically shown. Disconnects shall be coordinated with other trades and placed in the optimal locations to serve equipment and shall be installed in the least obtrusive location. Disconnects will have to be moved at the cost of the contractor when there is conflicts with NEC clearances, access to space, or servicing of equipment. Architect/Engineer will have final judgment of proper location.

2.32. MOTOR RATED SWITCHES (WITHOUT OVERLOAD PROTECTION):

- A. Motor Rated Switches without overload switches shall be rated for motor starting operation.
- B. Switches shall be 20 or 30 amp, two or three pole as required for the application.
 - 1. 20 amp two pole switches shall be 277 volt rated equal to Pass & Seymour #20AC2-HP.
 - 2. 30 amp two pole switches shall be 277 volt rated equal to Pass & Seymour #30AC2-HP or #7802 for higher HP applications.
 - 3. Three pole switches shall be 30 amp, 600 volt switches equal to Pass & Seymour #7803.
- C. Switches installed for site disconnect switches shall be equipped with padlocking provisions.
- D. Motor Rated Switches shall be equal to Pass & Seymour #7801 or #7830 outdoor locations, installed with tamper proof screws.

2.33. MANUAL MOTOR STARTERS (TUMBLER SWITCH TYPE WITH OVERLOAD PROTECTION):

- A. Starting and thermal overload protection for single phase motors 1/8 Hp to 1 HP shall be provided by manual motor starters with overload units rated as required by the specific motor to be served.
- B. Switches installed for site disconnect switches shall be equipped with padlocking provisions.
- C. Starters shall be by Cutler Hammer, General Electric, Square D, or Siemens with NEMA Type 1 enclosure or NEMA Type 3R enclosure where installed outdoors.

2.34. TRANSIENT VOLTAGE SURGE PROTECTORS (SURGE PROTECTIVE DEVICES):

- A. Provide transient voltage surge protectors (Surge Protective Devices) where indicated on the plans and schedules.
- B. Service Entrance Panelboards and at Subpanel Protectors shall be listed and labeled and components recognized in accordance with UL 1283 and UL 1449 Second Edition, including highest fault current of Section 37.3.
- C. All devices shall meet or exceed the following:
 - 1. NEMA LS 1-1992.
 - Minimum surge current capability, single pulse rated, per mode:
 a. Service Entrance 100 kA (200 kA per phase)
 - a. Distribution and branch panelboards 80 kA (160 kA per phase)
 - 3. UL 1449, Second Edition, Listed and Labeled, and Recognized Component Suppressed Voltage Ratings shall not exceed (1.2x50 □ s, 6kV open circuit and 8x20 □ s, 500A short circuit test wave forms at end of 6" lead):

Voltage	L-N	L-G	N-G	L-L
208Y/120v	400	400	330	700

- 4. Testing shall be done at the end of 6" leads with the complete unit including any fuses and all other components making up the unit.
- D. The devices shall have a minimum EMI/RFI filtering of –50dB at 100kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.
- E. Devices shall utilize MOV's of 25 mm diameter or larger, shall have pilot lights visible on the outside of the enclosure to indicate device operating condition, and shall provide contacts for remote monitoring of device condition.
- F. Devices shall be modular in design with individual module fusing and thermal protection.
- G. Devices shall incorporate visual alarm signals that indicate the failure of a single MOV and total loss of protection.
- H. Wye connected devices shall provide L-L, L-N, L-G, and N-G surge diversion with L-N/L-G bonded at service entrance devices. Delta connected devices shall provide L-L and L-G protection.
- I. Data Line Surge Protectors: Data Line Surge Protectors shall be UL 497B listed and labeled. The units shall be heavy duty devices utilizing a combination of silicone diodes and gas tube technology to provide surge protection.
- J. All devices shall have a minimum warranty period of five years, incorporating unlimited replacement of suppressor parts if they fail during the warranty period.

K. Transient voltage surge suppressors shall be manufactured by AC Data Systems, Advanced Protection Technologies, Current Technologies, Cutler-Hammer, General Electric, Joslyn, Liebert, or MCG.

2.35. FUSES:

- A. General: Fuses shall be UL listed time delay types with a minimum interrupting rating of 100,000 amps symmetrical.
- B. 200 amps and below: Provide Class RK-5 current limiting, time delay, rejection type as manufactured by Busman Manufacturing, Ferraz Shawmut, or Littlefuse.
- C. 201 to 600 amps: Class RK-1, current limiting, time delay, rejection type as manufactured by Bussman, Ferraz Shawmut, or Littlefuse.
- D. Above 600 amps: Class L current limiting, time delay, as manufactured by Busman Manufacturing, Ferraz Shawmut, or Littlefuse.

2.36. LABELING:

- A. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device.
- B. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic 0.125 inch thick, white with black center core.
- C. Provide red laminated plastic label with white center core where indicated.
- D. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core.
- E. Minimum size of nameplates shall beone by 2.5 inches.
- F. Lettering shall be a minimum of 0.25 inch high normal block style.
- G. See Panelboard details for proper labeling of all panelboards.

2.37. CONCRETE:

- A. Concrete for electrical requirements shall be:
 - 1. Composed of fine aggregate (sand), coarse aggregate (graded from three-sixteenth (3/16) inch to one (1) inch), Portland cement, and water proportioned and mixed so as to produce a plastic, workable mixture.
 - 2. Aggregates shall be free from detrimental amounts of dirt, vegetable matter, soft fragments, or other foreign substances.
 - 3. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities.
 - 4. Concrete shall have a minimum 3000 psi ultimate twenty-eight day compressive strength and a maximum three (3) inch slump.

PART 3 - EXECUTION

3.01. GENERAL:

A. This section includes the installation of the complete electrical system.

3.02. ELECTRICAL SERVICE:

- A. General: Arrange with local electric Utility Companies for service to be brought to the facilities as indicated on the drawings, and for installation of meters. Provide all material and labor not supplied by Utility Company so as to produce a complete installation meeting the Utility regulations.
- B. Coordinate all requirements with local utility company prior to bidding.
- C. Service requirements: It is the responsibility of this Section, prior to bid, to reaffirm with the Utility Companies involved, that locations, arrangement, Power Company voltage, phase, metering required, and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications,

contract price shall include an additional cost necessary to meet those regulations without extra cost to Owner after bids are accepted.

- D. Notify Architect of any changes required before proceeding with work.
- E. Fees and deposits:
 - 1. The Electrical Contractor shall be responsible for verification and payment of all utility fees associated with installation of the electrical service.
 - 2. The Owner shall pay the cost of establishing an electrical service account and permanent meter deposit.
- F. Metering: Obtain metering equipment from Utility Company and install in compliance with the Utility Company's requirements. The Electrical Contractor shall provide and install all necessary metering raceways, fittings, supports, connectors and ground conductor necessary for a complete installation. Provide 100# pull wire in all metering conduits.
- G. Main Service Equipment: Provide UL approved service entrance components as indicated on drawings or specified herein.
- H. Service lateral or feeder: Extend lateral or feeder of the size shown on drawings from service equipment to the point of service as indicated (verify exact location with Utility Company).
 - 1. For Overhead Service, provide and install service entrance fitting on conduit and leave sufficient slack conductor for connection to utility feeder 10' above finish grade, 12' above drive and 18' above street.
 - 2. For Underground Service, provide and install underground conduit to utility riser, as directed by Utility Company. Conduit shall be of size and quantity as indicated on drawings. Provide 480# polypropylene pull line in each empty conduit.
 - 3. For Underground Service, provide and install transformer pad, primary underground conduit to utility riser as directed by Utility Company, underground secondary conduit, and secondary conductors. Conduit shall be of size and quantity as indicated on drawings. Provide spare 4" conduit in transformer pad extending 2' beyond edge of pad with PVC cap. Provide 480# polypropylene pull line in each empty conduit.
 - 4. On service transformers with multiple taps, it shall be the responsibility of this section to coordinate tap selection with the electric utility to insure the proper nominal voltage.

3.03. GROUNDING:

- A. Bond the neutral conductor and various conductive materials in the building per NEC Article 250.
- B. Grounding Electrode System: A bare copper grounding conductor shall be bonded to grounding electrodes as specified below. This conductor shall serve as ground for system neutral and for building equipment bonding. Where conductor is #6, or smaller, or is subject to injury, it shall be run in conduit, Schedule 80 PVC or Rigid Galvanized to which the conductor shall be bonded at both ends.
 - 1. Grounding electrodes shall be as follows:
 - a. Cold water piping, if metal and in direct contact with the earth for 10 feet or more, at the point of entry into the building. Grounding electrode shall be attached with UL approved bronze clamp.
 - b. Building structural steel, if present and accessible.
 - c. Grounding electrode shall be attached with exothermic weld connector.
 - d. Foundation reinforcing bar system. Coordinate with General Contractor to provide turned up re-bar (sleeved) near service point for attachment of grounding electrode above grade. Grounding electrode shall be attached with UL approved bronze clamp or exothermic weld connector.
 - e. Driven ground rod(s).
 - 1) Three 3/4" x 10' copper weld rods shall be driven into the ground at the lowest point adjacent to the building, spaced a minimum of 10' apart.
 - 2) Ground rods shall be driven to 12" below grade.
 - 3) The grounding electrode conductor shall be attached to the rod(s) with UL approved bronze clamp or exothermic weld connector.

- f. Existing grounding electrode system. If an existing electrical service is in place, it must be bonded to the new grounding electrode system.
- C. Connections to grounding rods, building structure, counterpoise, and conductor junctions shall be made by exothermic weld unless specifically noted otherwise.
- D. Electric system (neutral) ground: The current carrying neutral leg of the wiring system shall be of insulated conductor, and shall be connected to the grounding electrode conductor only via the neutral connection at the service equipment. Each branch circuit or multi-outlet branch circuit shall be provided with a dedicated neutral conductor.
- E. Equipment grounding conductors:
 - 1. An equipment grounding conductor (copper with green insulation except where bare copper is used) shall be provided in all wiring raceways.
 - 2. Sizes shall be in accordance with NEC 250.
 - 3. The equipment grounding conductor shall originate in the same panelboard, panelboard section, as the circuit conductors.
 - 4. The equipment grounding conductor bonding the sections of multi-section panelboards shall be sized per NEC 250.
 - 5. The equipment grounding conductor is not included in number of branch circuit conductors indicated on the drawings.
- F. Gas piping: Bond interior above grade gas piping to the grounding electrode.
- G. Telephone service ground: provide a minimum #6 bare, solid copper grounding conductor from the electrical service grounding connection to the TBB. Leave six (6) feet minimum of free conductor. Install the conductor in PVC conduit where inside the building.
- H. Grounding electrode resistance shall be less than 15 ohms. The resistance of the grounding electrode shall be tested by the Fall of Potential Method.

3.04. EXCAVATION, CUTTING AND BACKFILLING:

- A. Provide cutting and patching, under the supervision of the General Contractor, as required for the work in Section 16.
- B. Locate all existing below grade and/or below floor utilities prior to beginning any site excavation or cutting of existing floor slabs. The Contractor shall repair any damage to existing utilities or systems.
- C. Saw cut existing concrete slabs and asphalt paving.
- D. Trenching:
 - 1. Dig trenches true to line, with a flat, even bottom.
 - 2. Width of the trench shall provide not less than 3 inches clearance from the conduit to each side of the trench.
 - 3. Insure that foundation walls and footings and adjacent load bearing soils are not disturbed in any way.
 - 4. Conduits shall be installed below footings where possible. Where a line passes under a footing, make crossing with the smallest possible trench to accommodate the conduits/sleeves.
 - 5. Where a line must pass adjacent to and blow the bottom of a column footing, or the corner of a continuous footing, backfill the trench with concrete up to the level of the footing bottom, for a distance away from the footing equal to the depth of the fill.
 - 6. Keep excavation free from water, by pumping if necessary.
 - 7. Where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level to proper elevation with sand or earth free from particles that would be retained on a 1/4 inch sieve.
 - 8. Remove and relocate existing obstructions as directed.
 - 9. The Contractor shall be responsible for the repair and/or replacement of any damage to existing utilities, structure, or finishes.
 - 10. Coordinate work with other trades as work progresses so cutting and patching will be minimal.

- 11. Refer to Section "Earthwork" for shoring, sub-soil assumptions and data, work around trees, surplus earth, etc.
- E. See Section 16100, "Conduit Installation, Below grade and below slab conduit installation", for installation of conduits in trenches.
- F. Backfilling:
 - 1. Immediately after inspection, cover conduits with 3" of compacted sand or earth free from particles that would be retained on a 1/4 inch sieve. Do not to disturb the alignment or joints of the conduits.
 - 2. Carefully backfill with 4" of earth free from clods, brick, etc., firmly puddling and tamping.
 - 3. Thereafter, puddle and tamp every vertical 4" for hand tamping or 8" for heavy duty mechanical tamping.
 - 4. Backfill shall meet the compaction requirements set forth in Division 2.
 - Backfilling Beneath Slabs and Pavement: Trenches beneath future slabs or pavement, including but not limited to buildings, drives, parking areas, sidewalks, playground surfaces, and equipment pads, shall be backfilled, from 3" above top of conduits to final grade, with crushed aggregate, AHD 825, type B, compacted in 4" layers to 100% ASTM 698.
 - 6. Install marking tape above conduits at 12 inches below grade.

3.05. SLEEVES, INSERTS, AND SUPPORTS:

- A. Provide and install No. 16 gauge galvanized steel or iron sleeves in all walls, floors, ceilings, and partitions. Sleeves shall have no more than 1/2" clearance around pipes and insulation.
- B. The contractor shall furnish to other responsible trades all sleeves, inserts, anchors and other required items which are to be built in by other trades for securing of all hangers or other supports by the Contractor.
- C. The contractor shall assume all responsibility for the placing and sizing of all sleeves, inserts, etc., and shall either directly supervise or give explicit instructions to other trades for their installation.
- D. The contractor shall seal all conduits through floors, smoke partitions, and floor partitions, with a sealant approved for the application.
- E. All sleeves through sound barrier walls and partitions shall be sealed with mineral wool.
- F. Through the floor conduit penetrations shall be sealed watertight.
- G. Furnish and install steel angles and channels as required for mounting and bracing heavy equipment and conduits. Steel shall be securely bolted or welded to structure and equipment bolted to the steel framework. Obtain the approval of the Architect prior to welding.

3.06. BELOW GRADE THRU WALL WATER SEALS:

- A. Each conduit penetrating exterior, below grade, cast cncrete walls shall have the annular space aroung the conduit sealed with an approved Thru Wall Water Seal System.
- B. Where the system includes water seal thru wall sleeves, the Electrical shall provide properly sized sleeves to the contractor responsible for constructing the walls and shall be responsible for the proper location of each sleeve.
- C. Where openings are to be core drilled, the Electrical Contractor shall be responsible for the core drilling and for coordinating proper sizing and location of each opening.

3.07. FIRE STOPPING:

- A. The Electrical Contractor shall be responsible for firestopping of all penetrations of fire rated partitions made by any and all lighting, power, and auxiliary circuiting, sleeves and/or equipment.
- B. The Electrical Contractor shall submit manufacturers' UL System drawings for the systems to be utilized. The systems shall be compatible with the partition ratings as indicated on the Architectural drawings and in accordance with details on the Electrical drawings.
- C. Penetrations of fire rated partitions shall be sealed with an approved fire sealant resulting in the completed penetration having the same fire rating as the partition.

- D. The installation shall be in accordance with the manufacturer's UL system detail and installation instructions to attain the required fire partition rating.
- E. Empty sleeves through 1 and 2 hour rated partitions shall be plugged with mineral wool.
- F. Sleeves through 4 hour rated partitions shall be plugged with mineral wool and fire stopping material.

3.08. ROOF PENETRATIONS:

A. Furnish roof flashing for all equipment, installed under Section 16, which penetrates through the roof. Flashing shall be approved by the Architect prior to installation.

3.09. CONDUIT INSTALLATION:

- A. Conduits shall be as follows:
 - 1. Overhead Service Entrance Rigid Galvanized Steel (RGS) Conduit or IMC.
 - 2. Underground Service Laterals: Schedule 40 rigid PVC in horizontal runs with rigid galvanized steel elbows turning up to vertical RGS.
 - 3. Where subject to moisture or mechanical injury RGS conduit.
 - 4. ALL conduits exposed to moisture or subject to mechanical damage shall be RGS. Where conduit exits building, the changeover from EMT to rigid shall be inside exterior wall.
 - 5. In open shop and industrial installations RGS shall be run to 10' A.F.F.
 - 6. All conduit exposed on the outside of the building envelope shall be Rigid Galvanized Steel (RGS) conduit. This includes all conduits on and/or under canopies or awnings.
 - 7. In concrete or solid masonry RGS conduit
 - 8. Above furred spaces or in cells of hollow masonry EMT
 - 9. Concealed inside drywall construction walls and above lay-in ceilings EMT.
 - 10. Exposed conduits:
 - a. Conduits installed exposed in shop, warehouse, and manufacturing areas shall be RGS up to 12' A.F.F. Conduits in such spaces above 12' A.F.F. may be EMT unless indicated otherwise on the drawings.
 - b. Exposed indoors in non-hazardous unfinished areas not subject to physical damage EMT
 - 11. Branch circuits in slab (3/4") PVC. Turn up through slab with RGS ells no exceptions. Extend rigid turn-ups 2" minimum above finish floor level.
 - 12. Circuits beneath building vapor barrier PVC. Turn up through slab with RGS ells no exceptions. All elbows 45° and greater shall be RGS in runs longer than 50 feet. Extend RGS turn-ups 2" minimum above finish floor level.
 - 13. Below Grade PVC with RGS, or rigid aluminum where applicable, elbows turning up to vertical. All below grade elbows 45° and greater shall be RGS in runs longer than 50 feet.
 - 14. Motor, HVAC equipment, and vibrating equipment connections flexible metal conduit, liquid tight flexible metal conduit outdoors, in kitchen and dishwashing area, or in other wet areas. Liquidtight flexible nonmetallic conduit shall be used only where specifically indicated.
 - 15. IMC may be used where RGS is indicated.
- B. Conduit sizes:
 - 1. Unless specifically indicated otherwise herein or on the drawings, the minimum conduit size shall be 3/4".
 - a. All conduits installed below grade or below slab shall be 3/4" minimum.
 - b. The minimum size for flexible lighting fixture "whips" shall be 3/8" and the maximum length shall be 6 feet. Lighting fixture "whips" shall be defined as flexible conduits with conductors feeding one or more recessed lighting fixtures installed in suspended, layin, acoustical ceiling systems from a single junction box.
 - c. ½" conduit may be for final connections to equipment or fixtures where conduit is less than three (3) feet in length and is extended from a junction box or from a ³/₄" conduit stub up.
 - 2. Conduits shall be sized in accordance with the National Electrical Code as adopted by the local authority having jurisdiction or as amended to date, except where a larger size is indicated on the drawings or specified herein.

- C. Layout:
 - 1. Generally follow the conduit layout shown on the drawings. However, the layout is diagrammatic only and must be adjusted for structural conditions, built-in equipment and other factors. Offsets are not indicated and must be furnished as required.
 - 2. Install all conduits concealed except in equipment rooms and where exposed runs are specifically indicated.
 - 3. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossings are unavoidable, then conduit shall be kept at least 1" from the covering of the pipe crossed.
 - 4. Eliminate trapped runs insofar as possible.
 - 5. Do not chase new work, but instead build in conduit as work progresses.
 - 6. Do not run conduit in cavity of exterior walls.
 - 7. Run concealed conduits in direct line with long sweep bends and offsets where practicable.
 - 8. Install exposed conduit with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings, with right-angle turns consisting of cast-metal fittings or symmetrical bends.
 - 9. Where conduits are indicated exposed overhead, runs down to wall outlets shall be concealed in wall.
- D. Conduit Installation:
 - 1. Securely fasten conduits to all sheet metal outlets, cabinets, junction and pull boxes with locknuts and bushings, taking care to see that stout mechanical and solid electrical connections are obtained.
 - 2. All conduits shall have bushings with smooth beveled throats installed at both ends prior to installing conductors. Split bushings around conductors shall be taken to indicate that the conductors were pulled into conduit without the proper bushings installed and a basis for requiring the replacing of the conductors.
 - 3. Conduits entering service enclosures (panelboards, disconnect switches, switchboards, motor control centers, etc. used as service entrance equipment) shall be provided with specification grade, insulating, grounding type bushings. Grounding bushing shall be bonded together and bonded to the service grounding buss.
 - 4. Support:
 - a. Raceways shall be securely and rigidly supported to the building structure in a neat and workmanlike manner, and wherever possible, parallel runs or horizontal conduit shall be grouped together on adjustable trapeze hangers.
 - b. Support shall be provided at appropriate intervals <u>not</u> exceeding eight(8) feet with straps, hangers, and brackets specifically designed for the application.
 - c. Channels shall be 1 inch for 18-inch wide trapeze, 1-3/8 inch for 24 to 30 inch, and 1-5/8 inch for over 30 inch wide trapeze.
 - d. Perforated steel straphangers, "butterfly clips", or tie-wire supports are not acceptable.
 - e. Conduits shall not be supported from ceiling support wires.
 - f. Conduits installed along wall surfaces shall be supported with galvanized steel brackets specifically designed for conduits and sized for the conduit used.
 - g. PVC conduits shall be supported per the NEC with PVC or stainless clamps and stainless steel hardware.
 - h. Attach to supporting devices with screws, bolts, expansion sleeves or other workmanlike means appropriate to the surface.
 - i. In stud walls, anchors shall be completely rattle proof.
 - j. For conduits in damp and wet locations, use stainless steel clamps and stand-offs, or galvanized malleable or cast iron clamps and spacers.
 - k. All mounting hardware for aluminum conduit shall be stainless steel.
 - I. Surface mounted conduits installed in kitchen and dishwashing areas shall be supported off walls approximately 3/16".
 - 5. Thread rigid conduits so that the ends meet in couplings; cut ends square, ream smooth and draw up tight.
 - 6. All field cut threads shall be cleaned with a solvent such as mineral spirits and painted with two coats of galvanize primer.

- 7. Cap conduit ends to keep out water and trash during construction.
- 8. Field made bends:
 - a. Avoid field-made bends where possible, but where necessary, use a proper hickey or conduit-bending machine.
 - b. Field made bends in PVC conduit shall be made with a heated PVC conduit bender.
 - c. Make no bends with radius less than six times the conduit diameter, nor more than 90 degrees.
- 9. Make changes in direction with pull boxes, symmetrical bends and/or cast-metal fittings.
- 10. Total bends in any conduit run shall not exceed the equivalent of four, quarter (90°) bends for a total of 360°, per NEC, between pull boxes.
- 11. Replace any crushed or deformed conduits.
- 12. Conduits passing through roofs shall be in place before roof is installed.
- 13. Conduits installed in concrete/grout filled CMU walls shall be Rigid steel or IMC conduits installed field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay. Painted on coating shall not be acceptable.
- 14. Where conduits pass through or across building expansion joints, provide hot-dipped galvanized expansion fittings with bonding jumpers.
- 15. Insure that all penetrations of firewalls are sealed per NEC and IBCC.
- 16. Right and left couplings shall not be used; conduit couplings of the Erikson type shall be used at location requiring such joints.
- 17. Paint all conduits exposed in finished spaces. Paint shall consist of one coat of zinc rich primer plus two top coats of water-based latex paint, color to match adjacent finishes. Verify colors and paint system with Architect.
- 18. All conduit runs entering the building from outdoors shall be sealed against moisture migration and condensation by filling with insulating type foam.
- 19. All conduits passing through walls of coolers or freezers shall have seal fitting installed on the outside of the cooler/freezer wall and within 3" of the wall. Fitting shall be sealed per manufacturer's recommendations.
- 20. Install telephone, data, intercom, and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- E. Below grade and below slab conduit installation:
 - 1. See Section 16100, "Excavation, Cutting, and Backfilling" for trenching and backfilling requirements.
 - 2. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable. Wrap shall extend a minimum of 1" above slabs or 3" above finished grade where there is no slab. Alternate methods must approved by Engineer prior to bids.
 - 3. Top of the conduit shall be not less than 30 inches below grade.
 - 4. Run conduit in straight lines except where a change of direction is necessary.
 - 5. Conduits stubbed up from below grade or slab into exterior walls shall be turned toward the interior of the building below slab fill perpendicular to the wall. Conduits shall not be turned out toward the exterior unless specifically indicated to do so.
 - 6. Placing of conduits below slab on grade:
 - a. Conduits 1-1/4" and larger shall be installed a minimum of 12" below the bottom of slab in the clay/sand fill below any gravel fill material.
 - b. Conduits 1" and smaller may be installed in the porous/gravel fill below the vapor barrier.
 - 7. Multiple Conduits:
 - a. Separate multiple conduits by a minimum distance of 2-1/2 inches horizontally and 3 inches vertically, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches horizontally and vertically.

- b. Where multiple layers of conduits are to be placed in a trench, each layer shall be placed in the trench, straight and parallel, clear fill material (see Excavation, Cutting, and Backfilling) placed and tamped in place to provide the specified spacing, and each subsequent layer placed in the same manner.
- c. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly.
- d. Conduits shall not be placed haphazardly in the trench.
- 8. Where conduits pass through footings or foundation walls:
 - a. Conduits roughed in beneath slab shall exit the foundation perpendicular to the building spaced approximately 3" apart. Conduits shall be arranged in a single horizontal row where practical.
 - b. Secure approval from the Architect and Structural Engineer prior to penetrating any footing or foundation wall.
 - c. Schedule 40 PVC sleeves shall be cast in the footings or foundation wall for the conduits to pass through.
 - d. Multiple sleeves shall have 3" clearance, vertically and horizontally, between the sleeves unless directed otherwise by the Architect and/or Structural Engineer.
- 9. Where PVC conduit is installed below grade a PVC to rigid metallic conduit coupling shall be installed in the horizontal run and a rigid galvanized steel conduit elbow installed to turn up to above grade. Where above grade conduits are indicated to be rigid aluminum the elbow turning up to vertical shall be rigid aluminum.
- 10. Rigid galvanized conduit shall extend a minimum of 6" above the finished floor level.
- 11. In hazardous areas the coupling shall be below grade and a single section of conduit installed up to 18" A.F.F. to accept the required seal fitting.
- 12. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used from 6 inches above the floor to the served equipment.
- 13. Conduits shall exit concrete slabs vertically.
 - a. Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.
 - b. At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.
- 14. Empty or spare conduit stub-ups shall be capped with a threaded cap.
- 15. Encasement Under Roads, Structures, and at other locations indicated on the drawings:
 - a. Under roads, paved areas, and other locations indicated on the plans install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts.
 - c. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assemblies shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly.
 - d. Install #4 rebar at each corner of the encasement and at not more than 18" on center vertically and horizontally on the sides of the encasement. #4 rebar hoops shall be installed at not more than 18" on center along the length of the encasement.
 - e. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.
- 16. Conduits to be installed under existing paved areas, which are not to be disturbed, and under roads and railroad tracks, shall be installed through a zinc coated, rigid steel, sleeve, jacked into place.
- 17. Conduits installed between handholes, manholes or other accessible areas shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points.
- F. Conduit Installation in concrete slabs:
 - 1. Conduit installed in concrete slabs shall be rigid steel or IMC. Rigid steel or IMC conduits installed in slabs-on-grade shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl

chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable.

- 2. At slabs on grade, conduit, 3/4" maximum, may be run in the slab; larger conduit shall be run below slab.
- 3. Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.
- 4. At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.
- G. Flexible conduit:
 - 1. At motor or equipment connections:
 - a. The maximum length allowable for flexible conduit shall be 36 inches except at lighting fixtures.
 - b. Flexible conduit installed outdoors shall be installed so as to provide an 8 inch minimum drip loop as measured from the lowest end of the conduit.
 - 2. At lighting fixture connections provide flexible steel conduit by one of the manufacturers named for rigid.
 - a. Maximum length allowable shall be 72 inches.
 - b. Support flexible conduit such that it does not contact the ceiling system, ductwork, or other equipment above the ceiling. The conduit shall not be attached to a ceiling or ceiling support system.
 - c. All fixture whips shall be supported within 12" of outlet/junction boxes with single hole clamps.
- H. Empty conduit:
 - 1. Install a #14 galvanized fish wire or polypropylene pull cord with 14-inch free ends in all empty power and/or auxiliary conduits.
 - 2. All conduits indicated to be terminated above the ceiling shall have an elbow turned out above the ceiling and shall be terminated with an insulating bushing.
 - 3. Empty conduits stubbed out of buildings below grade:
 - a. Empty conduits stubbed out of buildings below grade shall extend 5 feet outside of the building foundation.
 - b. Install a 12"x 12"x 6" concrete marker at grade, above the end of the conduits, with "ELEC" inscribed on top.
 - f. Note on as-built drawings the exact location where empty conduit(s) are stubbed out below grade to the building exterior. Indicate conduit sizes and number of each size.
- I. Conduit entries into enclosures, panelboards, and wiring troughs:
 - 1. Layout conduit entries carefully to allow clearances for the number and sizes of conduits, electrical equipment, and future expansion.
 - 2. In sheet metal equipment use Greenlee Knock-Out punch, or equal, to cut holes for conduit installation. Do not drill holes, or cut holes out with snips or torch.
 - 3. In cast enclosures and boxes drill conduit openings with correct size drill for tight fit.
- J. All junction box covers above the ceiling shall be labeled to which circuits or systems they contain.

3.10. CONDUIT BODIES:

- A. Conduit bodies shall be sized in accordance with NEC 370, and 373.
 - 1. Conduit bodies for conductor sizes AWG #4 and larger shall be mogul type bodies sized in accordance with NEC 370-28.
 - 2. Conduit bodies for conductor sizes AWG #6 and smaller shall be sized in accordance with NEC 370-16(c).

3.11. JUNCTION AND PULL BOXES:

- A. Junction and pull boxes shall be sized per NEC to accommodate the installed number and size of conductors and conduits.
- B. Boxes shall be securely fastened in place.

- C. Boxes serving lighting fixtures installed in accessible, suspended ceilings:
 - 1. Provide number of boxes as required to maintain fixture whips within the 6' maximum length.
 - 2. Generally attach to underside of structure above, in accessible location, to accommodate a maximum 6' flexible conduit connection to each fixture or fixture run.
 - 3. Where the structure above is more than 18" above the ceiling the boxes shall be supported within 18 inches of the ceiling with all thread rod and/or strut.
- D. Install galvanized steel utility box plates, by box manufacturer, at exposed conduit fittings or boxes.
- E. All junction box covers above the ceiling shall be labeled to which circuits or systems they contain.

3.12. WIRE AND CABLE INSTALLATION:

- A. No conductor shall be smaller than #12 except where so designated on the drawings or specified elsewhere.
- B. Multiwire lighting branch circuits shall be used where indicated.
- C. Wiring devices shall be connected such that each device can be removed without interrupting the neutral or equipment grounding conductors serving other outlets on the same circuit(s).
- D. Joints and splices in wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation. Wire nuts shall not be used for conductor #8 and larger.
- E. No splices shall be pulled into conduit.
- F. Both conductors and conduit shall be continuous from outlet to outlet.
- G. No conductor shall be pulled into the conduit until the conduit is cleaned of all foreign matter.
- H. When installing parallel conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, and type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded together at both ends in an approved manner.
- I. MC cable or Romex cable will note be accepted unless specifically called for on drawings.
- J. Wiring thru light fixtures and receptacles will not be accepted.

3.13. AUXILIARY GUTTERS (WIRING TROUGHS):

- A. Auxiliary Gutters shall be sized per NEC to accommodate the installed number, size, and orientation of conductors and conduits.
- B. Conductors serving a gutter shall be extended without reduction in size, for the entire length of the gutter.
- C. All taps and splices shall be made with insulated multi-tap connectors.

3.14. CIRCUITS AND BRANCH CIRCUITS:

A. Outlets shall be connected to branch circuits as indicated on the drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.15. WIRE JOINTS:

- A. Except for motor circuits, wire joints for #8 and smaller wire shall be made with twist on connectors.
- B. Wire joints and splices for motor circuits, for conductors #6 and larger, and for smaller conductors where other connectors are not rated for the number of conductors involved shall be made with split bolt connectors rated for the applicable conductor size, number of conductors, and conductor material.
 - 1. Properly tape and insulate all joints to attain the same insulation rating as the cable insulation.

- 2. Splices for #6 through #1 shall have a minimum or two (2) layers of rubber tape covered by a minimum of three (3) layers of electrical tape.
- 3. Splices for #1/0 and larger conductors shall have a minimum of two (2) layers of electrical filler tape covered by a minimum of three (3) layers of electrical tape.
- C. Splices in control conductors shall be avoided as much as possible. Stranded control conductor up to #12 may be connected or spliced with hand crimped type compression connectors. The connectors shall be of the proper size for the conductors being connected.
- D. Splices and joints made with mechanical/hydraulic type compression connectors:
 - 1. Connections and splices shall be made with connectors rated for the applicable conductor size and conductor material.
 - 2. Dies used shall leave the die number embossed in the connector. The Contractor shall provide the Engineer with the Manufacturer's connector and die chart prior to final inspection.
- E. Taps and splices in auxiliary gutters/troughs shall be made with insulated multi-tap connectors.
- F. Wire joints and splices made below grade shall be made with UL listed waterproof connectors, wire nuts, or splice kits.
- G. All joints and splices shall be made in junction boxes, wiring troughs, or conduit bodies sized per NEC.

3.16. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:

- A. Strut Systems: Strut shall be utilized to rack exposed piping vertically or horizontally on walls and across slabs (where applicable). Strut may be utilized to support piping above ceilings, for support of equipment, and elsewhere as deemed appropriate.
 - 1. Strut in conditioned spaces and above accessible ceilings shall be electro-galvanized.
 - 2. Strut installed outdoors, in mechanical rooms, and in other unconditioned spaces shall be hot-dipped galvanized.
 - 3. Strut installed in waste water treatment facilities, kitchens, dishwashing spaces, and labs shall be stainless steel.
 - 4. Strut fittings and hardware, including anchors, shall be same material as strut.
 - 5. Saw cut strut square, 6" minimum lengths. Strut on continuous runs of pipe shall be same length. File or grind burrs from saw cuts.
 - 6. After installation, electro-galvanized and hot-dipped galvanized strut shall be painted with two coats of zinc primer.

3.17. OUTLET BOX INSTALLATION:

- A. General: The drawings indicate approximate locations only; determine the exact location at the building in view of all structural and architectural conditions. Obtain Architect's verification of final locations.
- B. Outlet boxes shall be sized per NEC to accommodate the installed number and size of conductors, wiring devices, and conduits.
- C. Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.
- D. Typical boxes (for switches, receptacles and auxiliary systems): 4" square boxes ganged as required. Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.
- E. Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover.
- F. Boxes used with Exposed Conduit: 4" square utility boxes.
- G. Exterior Boxes: Cast-metal boxes, Crouse-Hinds Type FS or FD as appropriate. Make weatherproof with gasketed covers. Equal products by Appleton, Killark, O-Z/Gedney, or approved equal will be accepted.

- H. Sectional type switch boxes at least 2-1/2" deep may be used instead of typical box (but not where dry wall finish is applied over masonry back-up and not where multi- gang devices occur).
- I. Outlets in unfinished masonry walls may be slightly adjusted upward or downward to suit masonry courses, provided outlets are mounted at uniform heights throughout the installation.
- J. Coordinate installation of outlet boxes in masonry walls with the masonry contractor to insure that boxes are flush with face of wall and grouted smooth around boxes such that covers, fixtures or devices install flush on face of wall.
- K. Where outlets at different levels are shown adjacent, install in one vertical line where possible. Avoid conflict with wainscot caps, splash backs and upper cabinets by adjusting height slightly up or down as directed.
- L. Back to back boxes shall be staggered with at least 3 inches between boxes.
- M. Back to back boxes in fire rated partitions shall have a minimum of 24" horizontal and/or vertical separation between them.
- N. Backs of boxes three gang and larger installed in fire rated partitions shall be wrapped with self adhesive fire stopping tape.
- O. Coordinate carefully with appropriate trades the size and orientation (vertical, horizontal) of outlet boxes for thermostats, data outlets, fire alarm equipment, security equipment, and other control and communications outlets.
- P. Mounting Heights:

Switches, generally Safety switches Receptacles, generally Thermostat 48" A.F.F. to top of outlet
Center of Switch 48" A.F.F. or as required.
16" A.F.F. to bottom of outlet
Top of outlet 48" A.F.F. or as noted by Install
blank coverplates on all unused power and
auxiliary outlet boxes. Blank coverplates shall
match other cover plates installed in the facility.

3.18. WIRING DEVICES:

- A. Install wall devices vertically' unless otherwise noted, so that all devices of any given height will align exactly.
- B. Where boxes are not flush or square with the finished wall surface install wiring devices utilizing a leveler and retainer equal to Caddy #RLC or Steel City #SSF-SR.
- C. Plates shall be plumb and true with all four edges contacting wall surface.
- D. Mount receptacles with grounding terminals down.
- E. Do not install devices until plastering or other type wall covering has been completed; install ahead of painting work, but protect from paint spatter.
- F. Use screw terminal connections only.
- G. Do not gang dimmer switches with toggle switches.
- H. Each single or multi outlet receptacle, other than straight blade, 15 or 20 amp, 120 volts, NEMA 5-15R or NEMA 5-20R, shall be provided with matching cord plugs and a minimum of 8 feet of Type SOW cable matching the receptacle size and configuration.

3.19. ELECTRICALLY POWERED EQUIPMENT AND CONTROLS:

- A. Provide and install power circuits for all electrically powered equipment and controls.
- B. Heating, Ventilating, and Air Conditioning Control Wiring and Conduit:
 - 1. The electrical contractor shall be responsible for installing outlet boxes for flush mounted HVAC system thermostats in dry wall or masonry wall construction and, where called for on the plans, for surface mounted metallic receway in finished areas. Extend ³/₄" conduit from the outlet to above nearest accessible ceiling and terminate horizontally. Refer to the Mechanical/HVAC plans for thermostat locations and coordinate exact type outlet required and orientation with the Mechanical/HVAC contractor.

- 2. The Mechanical Contractor shall be responsible for the installation of all outlets and conduit for surface mounted devices in unfinished areas such as shops, warehouses, industrial facilities, etc.
- 3. The mechanical contractor shall furnish and install all low and line voltage control wiring required for the temperature control and/or ventilation systems.
- C. Where Fire Alarm system duct mounted smoke detectors and HVAC shut down interface relays are provided, the Electrical contractor shall provide wiring from the smoke detectors to the HVAC shut down interface relay. All circuiting from the shut down relay to the HVAC controls and/or starters shall be provided and installed by the Mechanical/Controls contractor.
- D. The mechanical contractor shall furnish all motor starters for the temperature control and/or ventilation equipment unless otherwise indicated on the electrical plans or elsewhere in these electrical specifications. The electrical contractor shall install all motor starters, except for equipment with factory installed starters, for the temperature control and/or ventilation equipment.
- E. Where exhaust fans are supplied with field installed speed controllers, the Electrical Contractor shall provide all necessary circuiting to the fan/speed controller and between the fan and the speed controller.

3.20. DISCONNECTING MEANS:

- A. Where required by the National Electrical Code and/or other applicable codes or authorities, or where indicated on the electrical plans, the electrical contractor shall furnish and install an approved disconnecting means for all electrically powered equipment and/or controllers for such equipment whether the disconnecting means is or is not shown on the electrical plans.
 - 1. The location, rating, and enclosure for the disconnecting means shall be as required by the National Electrical Code and/or other applicable codes or authorities.
 - 2. Manual motor starters with thermal overload protection may be used in lieu of safety switches for individual motors under 1 horsepower.
 - 3. Motor rated switches may be used for the disconnecting means when supplied of correct voltage, phase, amperage rating, and enclosure type.
 - 4. The disconnecting means shall be as manufactured by General Electric, Square D, Cutler Hammer, or Siemens.
- B. Where the disconnecting means shown on the electrical plans has a rating greater than the required code rating, the greater rating device shall be installed.
- C. An approved horsepower rated fusible safety switch shall be installed where the circuit overcurrent protection does not provide overload protection for the equipment served and where required to meet the equipment's listing requirements.
- D. Motor rated switches may be used as service disconnect switches when supplied with a padlockable, handle locking guard.
- E. Install an engraved phenolic nameplate on the front of each switch enclosure identifying the equipment served by the safety switch and source of power (i.e., panel name and circuit number). Plates shall be white with black lettering. The plates shall be permanently installed with stainless steel screws or stainless steel rivets.
- F. All disconnects installed in public areas or in areas readily accessible to the public shall be lockable and shall be furnished with a brass lock. Provide 10 keys for each lock. All disconnect locks furnished on the project shall be keyed alike.

3.21. PANELBOARDS:

- A. Panelboards shall be installed where shown on the drawings.
- B. Ratings and configurations shall be as scheduled and/or indicated on the drawings.
- C. The Electrical Contractor shall coordinate installation of equipment in Electrical and Electrical/Mechanical spaces with other trades such that Code required clearances and working space around the electrical equipment is maintained.
- D. Conduit termination:
 - 1. In general use panelboards with blank ends, without knockouts.

- 2. Layout conduit entries carefully to allow clearances for drywall or CMU wall thickness, and to accommodate the number and sizes of home run conduits and specified spare conduits.
- 3. Use Greenlee Knock-Out punch, or equal, to cut holes in panelboard ends and/or sides for conduit installation. Do not drill holes, or cut holes out with snips or torch.
- E. Phase arrangement in panelboards shall be per the NEC, phase A, B, C from front to back, top to bottom, or left to right as viewed from the front.
- F. In Delta connected systems the "high" leg shall be the B phase and shall be clearly marked with an orange outer finish.
- G. Multi-Section Panelboards:
 - 1. Sub-feed conductors shall be the same size as the conductors feeding the main section.
 - 2. Circuiting originating in one section shall not pass through another section.
 - 3. Circuit conductors and grounding conductors shall originate in the same panelboard section.
 - 4. A separate isolated grounding conductor shall be installed from the main section to the sub-feed section(s).
 - 5. Where the panelboard is rated for service entrance equipment the each sub-feed section shall have a separate isolated ground buss fed from the main section ground buss.
- H. Labeling:
 - 1. Each panelboard shall have an engraved phenolic plate permanently installed on the front of the panel with the panel name, current rating, and voltage rating.
 - 2. Where there is more than one nominal voltage system the panel shall also have an engraved phenolic plate describing the means of identification used to identify the phase and system of each ungrounded conductor of the system served by the panel.
 - 3. Plates shall be white with black lettering.
 - 4. Panelboard circuit numbers shall be as indicated on the panelboard schedules.

3.22. IDENTIFICATION AND LABELING:

- A. Feeder Designation:
 - 1. Non-ferrous identifying tags or pressure sensitive labels shall be securely fastened to all cables, feeders, and power circuits in vaults, pull boxes, manholes, switch gear and at termination of cables. Tags or labels shall be stamped or printed to correspond with markings on drawings so that feeder or cable number and phase can be readily identified.
 - 2. Where there is more than one nominal voltage system, each ungrounded system conductor shall be identified by phase and system wherever accessible per NEC. The means of identification shall be permanently posted at each branch-circuit panelboard.
- B. Color Coding of Conductors:
 - The ungrounded (phase) conductors and the grounded (neutral) conductors of each voltage system shall be identified by the following color coding method:
 c. 120/208 Volts, 3 Phase, 4 Wire:
 - 1) Grounded (neutral) Conductor --- White
 - 2) Ungrounded (phase) Conductors --- Black, Blue, Red
 - 2. Green shall be used for equipment grounding conductors only.
 - 3. The insulation color or color markings shall be visible in panelboards, switches, junction boxes, and all other locations where the conductors are accessible.
- C. Panelboard:
 - 1. Each Lighting and Power Panelboard shall contain a typed circuit directory listing all circuit breakers and the load served by each.
 - 2. Panelboard directories shall be typewritten, and shall include adequate descriptions for proper identification of individual circuits. Do not write in or on panelboards.
 - 3. On Distribution panelboards, provide and install an engraved laminated label for each circuit, indicating circuit's number and load served.
 - 4. Each panelboard shall have an engraved phenolic plate permanently installed on the front of the panel with the panel name, current rating, and voltage rating.

- 5. Where there is more than one nominal voltage system each panelboard shall have an engraved phenolic plate describing the means of identification used to identify each phase, neutral, and grounding conductors of the system served by the panelboard per NEC.
- 6. Plates shall be white with black lettering.
- D. Receptacles: Install a label on the face of the coverplate and tags or wire markers inside the outlet box identifying the panelboard and circuit number from which the outlet is served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of coverplate- black print on clear tape on light colored or stainless steel plates and white print on clear tape on dark colored plates. Embossed tape labels will not be accepted. Use durable wire markers or tags within outlet boxes.
- G. Disconnect Switches:
 - 1. Install an engraved phenolic nameplate on the front of each switch enclosure identifying the equipment served by the safety switch and source of power (i.e., panel name and circuit number).
 - 2. Plates shall be white with black lettering.
 - 3. The plates shall be permanently installed with stainless steel screws or stainless steel rivets. Plates installed with glue or other adhesives will not be accepted.
 - 4. Where motor rated switches are used as service disconnect switches, labeling shall be as described for receptacles.
- H. Junction boxes: Identify circuits enclosed in concealed junction boxes on the cover with permanent marking pen.
 - 1. For power and lighting circuits indicate panelboard of origin and panelboard circuit number(s).
 - 2. For auxiliary systems circuiting indicate the system and zone served.
- I. Service disconnects:
 - 1. An additional engraved sign shall be permanently attached next to panelboard circuit breakers, on enclosed circuit breaker enclosures, and/or on disconnect switches used as service disconnects to identify each main service disconnect.
 - 2. The sign shall be red with white lettering a minimum of $\frac{1}{2}$ " high.
 - 3. Where multiple main disconnects are utilized the labels shall identify each as one of a group, i.e., "Service Disconnect 1 of 3", etc. where there are three service disconnects.

3.23. CONCRETE:

- A. The Electrical Contractor shall be responsible for placing concrete for electrical equipment pads, lighting standard bases, electrical equipment supports, and at other locations as indicated on the electrical drawings and/or specified herein.
- B. This Contractor shall be responsible for size, location, and orientation of the pads, bases, etc. Any required additions or modifications to concrete due to incorrect size, location, or orientation shall be the responsibility of this contractor.
- C. Concrete shall be cured for a period of not less than seven (7) days prior to setting poles, transformers, switchgear, motor control centers, or other pad mounted equipment.
- D. Forms shall be completely removed after concrete has cured and prior to setting equipment.
- E. A smooth wood float finish shall be given to exposed, unformed concrete.
- F. Honeycombed, or otherwise defective areas of concrete shall be repaired by patching with cement mortar.

3.24. EQUIPMENT TOUCHUP AND PAINTING:

- A. Clean damaged and disturbed areas on all painted surfaces of enclosures, cabinets, and equipment, sand smooth, and apply primer, intermediate, and finish coats of paint to suit the degree of damage at each location. Paint shall be the manufacturer's supplied touch up paint or a matching paint. Prep all surfaces to be painted by removing all rust, dirt, oil, and any other material that might inhibit good paint adhesion by mechanical means and/or with solvents.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

- C. Repair damage to galvanized finishes with two coats of zinc-rich paint recommended by manufacturer.
 - 1. Paint cut ends.
 - 2. Paint all drilled and punched holes.
 - 3. Paint all knicks and scratches.
 - 4. Paint all field cut conduit threads.
- D. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

ELECTRICAL LEGEND

CEILING OUTLETS EF EXHAUST FAN

LA-1

LA-1

LA-1

BRANCH CIRCUITING

/	RUN CONCEALED UNDER
\frown	RUN CONCEALED IN CEI
A-1	HOMERUN TO PANEL. 2 #12, 1 #12 GROUND ///// 4 #12, 1 #1 NUMERALS INDICATE PA
10 A−1	HOMERUN TO PANEL. 2 #10, 1 #10 GROUND ~10////_ 4 #10, 1 #1 NUMERALS INDICATE PA
A-1	HOMERUN TO PANEL. 2 #8, 1 #10 GROUND ~8////4 #8, 1 #10 NUMERALS INDICATE PA
6	WHERE A NUMBER IS S INDICATES CONDUCTOR PROVIDE GROUND SIZED SIZE AS SHOWN. SIZE
\sim	LIQUID-TIGHT FLEXIBLE
E	SURFACE MOUNTED CON EMPTY CONDUIT WITH P
	PANELS AND PO
	PANELBOARD

CON CONTROL PANEL

WALL SWITCHES (UNLESS OTHERWISE NOTED, MOUNT 48" A.F.F.)

S_M MOTOR RATED TOGGLE SWITCH DISCONNECT, WITH THERMAL OVERLOADS A.C. TYPE, 20 AMP, 120/277 VOLT (EXPLOSION PROOF)

MISC	ELLANEOUS EQUIPMEN
CON	CONTROL PANEL

MISCELLANEOUS

FLOOR	OR	IN	GRADE
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ILING OR WALLS

- ANY CIRCUIT WITHOUT FURTHER IDENTIFICATION INDICATES ID - 3/4" C; ///-3 #12, 1 #12 GROUND - 3/4" C; 12 GROUND - 3/4" C; ETC. AS PER NEC. LETTERS AND ANEL AND CIRCUÍT NUMBER.
- ANY CIRCUIT WITHOUT FURTHER IDENTIFICATION INDICATES ND 3/4" C; -10///- 3 #10, 1 #10 GROUND 3/4" C; #10 GROUND 1" C; ETC. AS PER NEC. LETTERS AND ANEL AND CIRCUIT NUMBER.
- ANY CIRCUIT WITHOUT FURTHER IDENTIFICATION INDICATES 0 - 1" C; -8 # - 3 # 8, 1 # 10 GROUND - 3/4" C; 0 GROUND - 1 1/4" C; ETC. AS PER NEC. LETTERS AND
- ANEL AND CIRCUIT NUMBER. SHOWN NEXT TO OR ON THE CIRCUIT OR HOMERUN. THE NUMBER SIZE OTHER THAN #12 - NUMBER #6 CONDUCTORS INDICATED.) PER NEC TABLE 250-95 FOR MAX AMPACITY OF CONDUCTOR CONDUIT PER NEC ANNEX C.
- CONDUIT CONNECTION
- ONDUIT; RUN PARALLEL OR PERPENDICULAR TO BUILDING LINES PULLWIRE RUN CONCEALED IN CEILING OR WALLS

)WER

Α	AMPERE
ADA	AMERICANS WITH DISABILITIES ACT
AFF	ABOVE FINISH FLOOR
AIC	AMPERE INTERRUPTING CAPACITY
ATS	AUTOMATIC TRANSFER SWITCH
С	CONDUIT
CL	CENTER LINE
CWP	COLD WATER PIPE
EM	EMERGENCY
EMT	ELECTRIC METALLIC TUBING
GFI	GROUND FAULT INTERRUPTER
GRC	GALVANIZED RIGID METAL CONDUIT
GRD	GROUND
МСВ	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MLO	MAIN LUGS ONLY
MT	MOUNT
N	
	NUT IN CUNIKACI NATIONAL ELECTRICAL CODE
	NATIONAL ELECTRICAL CODE NATIONAL FLECTRICAL MANUFACTURER'S ASSOC.
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NL	NIGHT LIGHT
NTS	NOT_TO_SCALE
P	POLE
PVC	
SLD	SINGLE LINE DIAGRAM
TBB	TELEPHONE BACKBOARD
TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSORS
UL	UNDERWRITER'S LABORATORY
U.N.O.	UNLESS NOTED OTHERWISE
V	VOLTAGE
W	WIRE
W F #	
₩ T	NUMBLK NEMA 30 WEATHEDDDAAE ENALASHDE
	NEMA JA WEATHERPROOF LINGLUJUKE
-TA	HEMA TA HEATHEN NOOL CONNOSION ENCLOSURE

GENERAL ELECTRICAL NOTES:

- 1. THE SERVICE VOLTAGE TO THE FACILITY IS 120/208 VOLT, 3 PHASE, 4 WIRE.
- 2. INSTALLATION SHALL COMPLY WITH THE NATIONAL ELECTRICAL CODE, STATE AND LOCAL CODES, AND MANUFACTURER'S RECOMMENDATIONS.
- 3. MAINTAIN ALL CLEARANCES FOR ELECTRICAL EQUIPMENT PER THE NEC.
- 4. COORDINATE ROUGH-IN OF ALL ELECTRICAL DEVICES WITH ARCHITECTURAL FLOOR PLANS, ELEVATIONS AND MILLWORK SHOP DRAWINGS PRIOR TO ROUGH-IN. AVOID ALL BACKSPLASHES AT COUNTERS.
- 5. ALL DIMENSIONS INDICATED IN THESE DOCUMENTS ARE FOR REFERENCE AND COORDINATION PURPOSES ONLY. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL DIMENSIONS IN THE FIELD, AND COORDINATING WORK WITH OTHER TRADES TO AVOID CONFLICTS.
- 6. VERIFY ALL DOOR SWINGS WITH ARCHITECTURAL BEFORE ROUGH-IN OF LIGHT SWITCHES TO ENSURE PROPER SWITCH LOCATION.
- 7. THE LOCATION OF OUTLETS, FIXTURES, AND EQUIPMENT SHOWN ON THE DRAWINGS ARE APPROXIMATE, OFFSET AS NEEDED OR AS REQUESTED BY THE OWNER. THE OWNER SHALL HAVE THE RIGHT TO RELOCATE ANY OUTLETS OR FIXTURES BEFORE THEY ARE INSTALLED WITHOUT ANY ADDITIONAL COST.
- 8. COORDINATE EXACT LOCATION OF ALL ELECTRICAL FLOOR DEVICES WITH ARCHITECT PRIOR TO INSTALLATION.
- 9. ALL CONDUIT SIZE SHALL BE A MINIMUM 3/4" UNLESS NOTED OTHERWISE IN THE DRAWINGS OR SPECIFICATIONS. 10. ALL ELECTRICAL RACEWAYS AND CABLING SHALL BE INSTALLED CONCEALED WITHIN THE CONFINES OF THE BUILDING FOUNDATIONS EXCEPT THOSE SPECIFICALLY SERVING LOADS OR EQUIPMENT EXTERIOR OF THE BUILDING. ALL SUCH RACEWAYS SHALL BE A MINIMUM 18" INSIDE FOUNDATIONS AND POWER AND COMMUNICATIONS RACEWAYS SHALL BE SEPARATED BY A MINIMUM 18".
- 11. ALL CONDUITS INSTALLED UNDERFLOOR SHALL BE ROUTED UNDER STRUCTURAL CONCRETE FLOOR SLABS. CONTRACTOR SHALL NOT INSTALL CONDUITS IN CONCRETE FLOORING WITHOUT THE EXPRESS WRITTEN PERMISSION OF THE STRUCTURAL ENGINEER. CONDUITS PENETRATING THRU CONCRETE FLOORS SHALL ADHERE TO THE ELECTRICAL SPECIFICATIONS AND RECOMMENDATIONS OF THE STRUCTURAL ENGINEER.
- 12. ALL RACEWAYS INSTALLED ON EXTERIOR OF THE BUILDING, INCLUDING CONDUIT UNDER CANOPIES, SHALL BE GRC. EMT WILL NOT BE ACCEPTED.
- 13. ALL RACEWAYS SHALL BE SUPPORTED PER NEC AND AT LEAST EVERY 10' AND WITHIN 3' OF EVERY JUNCTION BOX. RACEWAYS SUPPORTED ON BOTTOM OF SECONDARY CEILING SHALL BE SUPPORTED FROM THE STRUCTURE NOT FROM THE GYPBOARD CEILING.
- 14. ALL EMPTY WALL MOUNTED JUNCTION BOXES SHALL BE PROVIDED WITH A WALL BLANK AND ALL EMPTY RACEWAYS SHALL BE PROVIDED WITH A PULL WIRES.
- 15. PROVIDE ALL CONDUIT STUBS WITH A PROTECTIVE COLLAR.
- 16. INSURE THAT ALL PENETRATIONS OF FIRE WALLS AND DECKS ARE PROPERLY SEALED PER INTERNATIONAL BUILDING CODE 712 AND WITH AN UL APPROVED DEVICE OR FIRE CAULK. REFER TO ARCHITECTURAL PLANS FOR THE LOCATIONS OF RATED FIRE WALLS AND UL ASSEMBLY LOCATIONS AND TYPES AND BID ACCORDINGLY.
- 17. PROVIDE A CONDUIT EXPANSION JOINTS WITH BONDING JUMPER IN ALL CONDUITS CROSSING AN EXPANSION JOINT. REFER TO ARCHITECTURAL DRAWINGS FOR EXPANSION JOINT LOCATIONS.
- 18. ALL UNDERGROUND CONDUITS RUNS ENTERING THE BUILDING SHALL BE SEALED TO PREVENT THE ENTRANCE OF MOISTURE.
- 19. ALL FLEXIBLE CONDUITS ON THE EXTERIOR, IN WET LOCATIONS OR ANY MECHANICAL ROOM SHALL BE LIQUID TIGHT WITH SUITABLE FITTINGS.
- 20. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SEALING AROUND DEVICES, PENETRATIONS, OUTLETS, AND CONDUITS THAT PENETRATE THE WALLS ABOVE THE CEILING TO MAINTAIN SOUNDPROOFING. CONTRACTOR SHALL VERIFY THAT THE OPENINGS SIZES ARE LESS THAN 1/2" ON ALL SIDES OF THE PENETRATIONS. ALL OPENINGS IN EXCESS OF 1/2" SHALL BE CAULKED/SEALED WITH SHEET ROCK MUD. THE DRYWALL CONTRACTOR SHALL BE RESPONSIBLE FOR SEALING PENETRATIONS IN PLACE WHEN THE SHEETROCK ARE INSTALLED. PENETRATIONS MADE AFTER THE DRYWALL CONTRACTOR HAS FINISHED IN AN AREA SHALL BE SEALED BY THE CONTRACTOR MAKING THE PENETRATION.
- 21. ALL JUNCTION BOX COVERS ABOVE THE CEILING SHALL BE CLEARLY MARKED WITH WHICH CIRCUITS OR ELECTRICAL SYSTEM THEY CONTAIN.



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TED: SURFACE VOLTAGE: 120/208 VOLTS, 3 PHASE, 4 WIRE					
				_	
	DOLE	(VA) PER PHASE		
AMP	POLE	PHASE A	PHASE B	PHASE C	
					BUSSED SPACE
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		0	0	0	SUB TOTAL (VA)

2. MAIN BREAKER SHALL BE 100% (FULLY) RATED. 3. PROVIDE PANEL WITH NAME PLATE INDICATING AIC RATING. SEE DETAIL.

4. PROVIDE ARC FAULT LABEL PER DETAIL.

5. PROVIDE NEMA 3R ENCLOSURE

-PANEL NAME

DATE OF CALCULATION:__/___ - PROVIDE DATE THAT CALCULATION WAS PERFORMED

DETAIL - SERVICE ENTRANCE FAULT CURRENT NAMEPLATE

PANELBOARD NOTES:

1. PANELBOARDS SHALL BE INSTALLED AND ALL CLEARANCES MAINTAINED IN ACCORDANCE WITH THE NEC. ALL PANELBOARDS SHALL BE UL LISTED AND INSTALLED IN ACCORDANCE WITH THAT LISTING. 3. PANELBOARDS SHALL BE FURNISHED COMPLETE WITH THE PROPERLY SIZED ENCLOSURE, INTERNAL HARDWARE

COMPONENTS, SUPPORTING STRUCTURES, ETC., FOR A COMPLETE INSTALLATION. 4. FURNISH EACH PANELBOARD WITH A GROUND BAR BONDED TO THE PANEL ENCLOSURE. 5. THE TERMINATION POINT OF THE FEEDER SERVING EACH ASSEMBLY SHALL BE AT THE NEAREST POINT OF

- FEEDER ENTRY INTO THE PANEL, SO AS TO MINIMIZE CONDUCTOR FILL IN THE ENCLOSURE. COORDINATE TOP/BOTTOM FEED PANELBOARD PROVISIONS WITH EACH FEEDER INSTALLATION. 6. PROVIDE THE PROPER SIZE AND QUANTITY OF CONDUCTOR TERMINATION POINTS OR LUGS (MULTIPLE LUGS WHEN PARALLEL FEEDERS ARE USED) ON BUSES AND CIRCUIT BREAKERS FOR THE RESPECTIVE SIZE AND
- NUMBER OF CONDUCTORS INDICATED. 7. ALL FLUSH-MOUNTED PANELBOARDS SHALL BE PROVIDED WITH AT LEAST SIX (6) 3/4" SPARE CONDUITS
- STUBBED TO ABOVE THE NEAREST ACCESSIBLE CEILING. 8. PANELBOARDS SHALL BE FULLY RATED. SERIES RATED PANELBOARDS WILL NOT BE ACCEPTED. 9. ALL PANELBOARDS SHALL BE CLEARLY MARKED TO COMPLY WITH NEC ARTICLE 110.16 WITH REGARD TO
- POTENTIAL HAZARDS OF ARC FLASH. 10. ALL PANELBOARDS SHALL BE "DOOR-IN-DOOR" OR "HINGED-FRONT-TRIM" CONSTRUCTION. 11. COMPLY WITH NEC ARTICLE 408.4. PROVIDE A TYPED CIRCUIT DIRECTORY THAT INDICATES WHAT EACH CIRCUIT IS SERVING. FOR LIGHTING AND RECEPTACLE CIRCUITS. INCLUDE THE ROOM NUMBER IN THE CIRCUIT
- DESCRIPTION ON THE DIRECTORY.
- PROVIDE FINAL ACCEPTANCE UNTIL THESE NAMEPLATES ARE PROVIDED 13. MANUFACTURER THAT WILL BE PROVIDING PANELBOARDS ON THIS PROJECT SHALL BE RESPONSIBLE FOR PERFORMING A SHORT CIRCUIT ANALYSIS AND TIME-CURRENT COORDINATION (TCC) STUDY, WHICH DEMONSTRATES THAT THE UPSTREAM OVERCURRENT PROTECTIVE DEVICE NEAREST TO THE FAULT LOCATION WILL OPERATE BEFORE OVERCURRENT PROTECTIVE DEVICES WHICH ARE FURTHER UPSTREAM (I.E. SELECTIVE COORDINATION). INCLUDE COORDINATION STUDY IN THE SHOP DRAWING PACKAGE FOR THE PANELBOARDS FOR REVIEW BY THE ENGINEER OF RECORD. AIC RATINGS MAY BE LOWERED BASED ON STUDY.

WHITE BACKGROUND WITH BLAC	k letters
PNL	PANEL NAME
120/208V, 3PH, 4W	PANEL VOLTAGE,
FED FROM PNL	WHERE PANEL IS

DETAIL - TYPICAL PANELBOARD NAMEPLATE 3 ` NO SCALE **E−2** /

TYPICAL NORMAL POWER NAMEPLATE

SHEET NOTES:

 $\langle 1 \rangle$ coordinate with local utility company for overhead secondary to be brought to building and pay all ASSOCIATED FEES. COORDINATE PRIOR TO BIDS AND PAY ALL ASSOCIATED FEES. COORDINATE PRIOR TO BIDS AND BID ACCORDINGLY.

GENERAL NOTES:

- 1. COORDINATE WITH MECHANICAL/PLUMBING DRAWINGS FOR EXACT LOCATIONS OF EQUIPMENT.
- 2. MOUNT EXTERIOR DISCONNECTS ON EXTERIOR WALLS AT LEAST 18" FROM WINDOWS. LOCATIONS OF DISCONNECTS AND EQUIPMENT ARE SHOWN FOR DRAWING CLARITY PURPOSES ONLY.
- 3. COORDINATE WITH MECHANICAL/PLUMBING CONTRACTORS TO INSURE OVERCURRENT PROTECTION DEVICES FOR THEIR EQUIPMENT IS SIZED PER MANUFACTURER'S RECOMMENDATIONS. ENGINEER SIZED OVERCURRENT PROTECTION ACCORDING TO MECHANICAL/PLUMBING DRAWINGS AND SPECIFICATIONS, ACTUAL EQUIPMENT SUPPLIED MAY DIFFER. ELECTRICAL CONTRACTOR SHALL WORK WITH OTHER TRADE DISCIPLINES TO INSURE ANY
- CHANGES WILL BE INSTALLED CORRECTLY AT THE COST OF THE PERSON MAKING THE CHANGES. 4. ALL FLEXIBLE CONNECT TO HVAC UNITS SHALL BE RUN PARALLEL TO HARD SURFACE AND STRAPPED AT LEAST EVERY 2'. 5. CONTRACTOR SHALL PROVIDE CONDUIT FOR MECHANICAL CONTROLS. COORDINATE EXACT LOCATIONS WITH
- MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.
- 6. ALL DISCONNECTS TO HAVE NAMEPLATE AS SHOWN IN DETAIL (2) THIS SHEET, NO EXCEPTIONS. 7. PROVIDE DEDICATED NEUTRALS FOR EACH MULTIWIRE HOMERUN PER NEC.

WHITE BACKGROUND WITH BLAC	K LETTERS
D	EQUIPMENT NAME
120/208V, 3PH, 4W	DISCONNECT VOLTAGE, PHASE, & WIRE
FED FROM PNL	WHERE PANEL IS FED FROM

TYPICAL NORMAL POWER NAMEPLATE

E-2

DETAIL - TYPICAL DISCONNECT NAMEPLATE NO SCALE



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SHEET TITLE : FLOOR PLAN - POWER					
MCKEE JOB # : DRAWN BY : DATE: REVISED DATE: REVISED DATE:	17.189 J. TILLERY 09.21.17				

SHEET NO. : E-2