SECTION 26 00 00 - ELECTRICAL

PART 1 GENERAL

1.1 SCOPE

A. The work covered by this section includes the furnishing of labor and materials, equipment, and incidentals and the performing of operations in connection with "electrical work" as indicated on the drawings and/or specified herein and including incidental items to effect a finished, complete and operable system as indicated. The electrical work shall include but not be limited to:

1. Provide service conduit and conductors as indicated on the plans.
2. Perform all electrical work in accordance with requirements of 2011 NEC, NFPA 72 and NFPA 101.
3. Provide new wiring for lights and receptacles as indicated. All new wiring shall be minimum 12 ga. copper.
4. Provide new wiring and disconnects for HVAC equipment and controls as required.
5. Provide GFCI protection for receptacles in all bathrooms and kitchens in accordance with 2011 NEC.
6. Provide AFCI protection in all dwelling units in accordance with 2011 NEC.
7. Provide new tamper resistant receptacles in dwelling units in accordance with 2011 NEC.
8. Provide complete Addressable fire alarm system including masterbox per City of Portland Standards. Provide complete smoke detector coverage per NFPA 72 and City of Portland ordinances. Provide audio/visual alarms per NFPA 72 and City of Portland ordinances. Provide tamper and flow switched on sprinkler systems and pulls stations per NFPA 72. Contact City Of Portland Fire Marshall Ben Wallace for inspections. 207.874-8405.
9. Provide CO2 detection in all apartments near sleeping areas.
10. Provide light fixtures as indicated on the plans.
11. Provide CATV and Tel cable and jacks in all units as indicated on the plans.
12. Provide fire alarm devices per NFPA 72 and ASME A17.1 for the new elevator.
13. Provide new exterior lighting as indicated on the drawings.

Work shall be subject to the conditions of the contract and shall be in strict accordance with these plans and specifications.

B. Before submitting his/her bid, the Electrical Contractor is required to visit the site and survey the conditions likely to be encountered in the performance of the electrical work. Failure to familiarize himself/herself with said conditions shall not relieve the Contractor of responsibility for full completion of the work in accordance with the provisions of the Contract.

C. The term "Contractor used hereinafter shall designate the Electrical Contractor.

D. Any questions regarding this specification or the Electrical Drawings must be addressed in writing to the Architect before bids close; after close of bids, the Architect's interpretation of the meaning and intent of the specifications and drawings shall be made according to the provisions of the General Conditions.

1.2 RELATED DOCUMENTS

A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work.

B. Drawings and general provisions of Contract including General and Supplementary Conditions and all Division 1 specification sections.

C Provision of waste management: Section 01 74 19, Construction Waste Management and Disposal.

D Provision of general LEED requirements and forms: Section 01 81 13, Sustainable Design and LEED Requirements."

1.3 CODES AND STANDARDS

A. Where referred to, published standard specifications of technical societies, trade associations and governmental agencies codes and regulations of Underwriters and protective organizations, Federal, State and Municipal regulations and codes and publications of a similar nature shall be the edition current as of the date of this Specification.

B. The applicable requirements of the latest publications of the following organizations shall apply to the work under this section as if fully written herein:

1. American National Standards Institute, Inc. (ANSI)
2. National Electrical Manufacturers Associations (NEMA)
3. National Fire Codes (NFPA)
4. Underwriters Laboratories, Inc. (UL)
5. Federal, State and Municipal Building Codes, and all other Authorities having jurisdiction.
6. National Electrical Code (NEC)
7. Americans with Disabilities Act (ADA)
8. Occupational Safety and Health Administration (OSHA)

1.4 MATERIALS AND EQUIPMENT

A. Materials shall be of the best quality. Workmanship shall be of highest grade and construction shall be done according to best practices of the trade.

B. Provide, when required, labeled samples of material or equipment specified herein or proposed to be used in this work.

C. Where words "furnish", "provide", or "install" are mentioned, either singly or in combination, these words are hereby interpreted to mean "furnish and install" or "provide and install", including materials complete with connections, supplemental devices, accessories and appurtenances, unless specifically noted otherwise. These words are

likewise hereby interpreted as being prefixed to materials, equipment, and apparatus hereinafter mentioned, either in abbreviated or scheduled information or in the technical sections of the specifications.

1.5 SHOP DRAWINGS

A. Submit to the Architect for approval not less than eight (8) sets of Shop Drawings of the materials, fixtures and equipment to be incorporated in the work. Information shall contain specific reference to catalog numbers and shall be qualified in writing as required. No considerations will be given to brochure or catalog information not specifically designated or referenced to the specification by an identifying number.

B. Shop drawings that are facsimiled, (FAX) produced, or photocopies of FAX documents will not be considered or reviewed. Only originals and or photocopied originals, complying with paragraph A above will be considered.

C. Before consideration, electrical submittal packages shall include cover pages for each of the electrical equipment groups, i.e. panelboards, lighting, fire alarm, devices, emergency call system, apartment intercom/security system.

D. Shop drawings must bear the Architect's review stamp. In the event that the Architect rejects shop drawings, the shop drawing must be revised and resubmitted for review.

C. LEED Submittals - Product data as per Section 01 81 13, Sustainable Design and LEED Requirements.

D. Section 01 33 00 - Submittal Procedures: Submittal procedures.

E. Product Data: Submit data on product characteristics, performance criteria and limitations.

F. Manufacturer's Installation Instructions: Submit procedure for preparation and installation.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 SUSTAINABLE DESIGN REQUIREMENTS AND SUBMITTALS

A. Conform to Section 01 81 13 - Sustainable Design Requirements and provide LEED Submittals, Manufacturer's Certificates and Product Cost Data, where applicable, for targeted LEED Credits.

1. Refer to Sustainable Design Requirements, Attachment 1: LEED for Homes – Mid-Rise Pilot Simplified Project Checklist for a description of each Credit.

B. Targeted LEED Credits

1. The Scope of Work outlined in this specification is targeted for one or more Credits in order to achieve the specified Certification level of LEED for Homes – Mid-Rise Pilot program.
2. Refer to Drawing L-1 LEED for Homes – Mid-Rise Scope Matrix for specific Credits that are applicable to Work included in this specification Section.
3. Refer to Section 01 81 13 - Sustainable Design Requirements for required Contractor requirements of each listed LEED Credit.

1.7 SUBSTITUTIONS

A. Reference in the specifications or on the drawings to any product, material, fixture, form or type of construction, by proprietary name, manufacturer, make or catalog number, establishes a standard of quality or design and is not meant to limit competition. Use any equivalent substitute provided favorable written review by the Architect is first obtained.

1.8 CODES, PERMITS, INSPECTIONS

A. The installation shall comply with laws and regulations applying to the electrical installation in effect at the site with regulations of any other governmental body of agency having jurisdiction, and with regulations of the National Electrical Code (NEC).

B. Obtain and pay for permits required by the ordinances at the site. After completion of the work, furnish the Owner a certificate of final inspection and approval from the Inspection Bureau having jurisdiction.

C. Inspections and tests shall be made in accordance with the requirements of Division One. Rejected materials shall be removed from the site and new materials furnished, retested and installed to the satisfaction of the Architect without additional cost to the Owner.

D. Arrange for periodic inspections by the local Electrical Inspector during construction.

1.9 TEMPORARY LIGHT AND POWER

A. Temporary light and power shall be installed and maintained by the Electrical Contractor for use by all trades for the duration of construction complete with all wiring, switches, protective devices and similar equipment as may be required. Arrangement for the temporary service with the Power Company is the responsibility of the Electrical Contractor. Power bills will be paid by the General Contractor. Provide 120/208 volt 100 ampere, drop box similar to standard CMP detail 980-31.1.4. Provide 150 watt long life, rough service, frosted A lamps with plastic “cages” as needed.

1.10 ACCEPTANCE

A. Before acceptance of the work under this section, damaged or imperfect materials shall be refinished or replaced, debris, scaffolding and tools shall be removed and premises shall be "broom clean" to the satisfaction of the Owner.

1.11 GUARANTEE

A. This contractor shall guarantee materials and installations under normal use to be free of defects and poor workmanship for a period of one (1) year from the date of acceptance. Any replacement of parts or adjustments, including labor made necessary by inherent defects, shall be provided by the contractor without cost to the Owner within the guarantee period.

1.12 PROTECTION OF EQUIPMENT AND MATERIALS

A. Protect equipment and material for the electrical work after delivery, before and after installation. This protection must be extended against pilferage, dampness and damages from all causes until the work is accepted by the owner.

1.13 ELECTRICAL REFERENCE SYMBOLS

A. Symbols shown on the Drawings show approximate locations of fixtures, outlet boxes, conduit runs and other equipment, unless otherwise detailed. The exact location shall be governed by structural conditions and obstructions. This is not to be construed as to permit redesigning systems. Outlets shall be connected from circuits as shown on the drawings. Locate and install boxes and equipment where they will be readily accessible.

1.14 MATERIALS AND INSTALLATION

A. Only the best materials of each class specified shall be used and the installation shall be made in a neat and workmanlike manner, complete in every detail, ready for immediate satisfactory operation by the Owner.

1.15 WORK BY OTHERS

A. Trenching and backfill

B. Painting

C. Cutting and patching

D. Telephone and cable TV service entrance cable and interface.

E. Coordinate work to meet requirements of cable and telephone utilities.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. Unless otherwise indicated, the materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design that complies with the specification requirements.

B. Materials shall be delivered to the site in the original sealed containers of packages bearing the manufacturer's name and brand designated. Materials shall be stored in a clean, well-ventilated, warm area. Care shall be exercised in handling materials during delivery, storage and installation. Materials damaged, in the opinion of the Architect, shall be replaced at no additional cost to the Owner.

2.2 EQUIPMENT MOUNTING AND SUPPORTS

A. Provide supports including supplementary steel, channels, rods and guys required for the proper installation, mounting and support of equipment.

B. Supports shall be firmly attached and connected to building structural elements and constructed in an acceptable manner. Continuously threaded rods less than 3/8" in diameter, tie wire, or metal straps are not acceptable.

C. Supports in structural systems shall be installed as an integral part of the structural system. Explosive or cartridge driven type anchors, insert or supports are not acceptable.

D. Except as otherwise required by the Contract Documents the type and size of supports shall be as determined by the Contractor and shall be of sufficient strength and size to allow only a minimum deflection as required by codes or standards and the support manufacturer's requirements for loading.

E. Inform all parties as to location, size details and method of attachment of supports and the weight which the support is to carry, so that the installation may be coordinated.

F. Supports shall be installed in a neat and workmanlike manner, perpendicular or parallel to walls, floor, columns, beams or ceilings.

2.3 GROUNDING

A. Furnish and install grounding system as required by codes or standards.

B. Grounding terminal on receptacles and switches shall be bonded to outlet box with grounding conductor to establish grounding continuity if it is metallic.

C. Flexible metal conduit and electric metallic tubing feeder raceways shall include grounding conductor.

D. Grounding conductors shall be stranded copper wire with green color insulation. Grounding conductors shall be run with all circuits, feeders, etc. Raceways alone will not be considered as a grounding means.

E. Grounding bushings shall be provided for raceways where required.

F. Provide exterior inter-system ground in accordance with NFPA 70, 250.94.

2.4 PANELBOARDS

A. Panelboard cabinets shall be of the dead-front safety type, provided with the size and number of single, double or triple pole branches as indicated in the schedule. Cabinets shall be constructed of zinc coated sheet steel and shall conform to Underwriters Laboratories, Inc, Standard for Cabinet and Boxes. Cabinet heights shall not exceed 72" and cabinets shall be mounted so that the distance from the floor to center of the top circuit breaker will not exceed 6', **except in handicapped units where the cabinet height shall not exceed 48" AFF.** Cabinets shall be provided with trims having adjustable trim clamps. Trims, unless otherwise noted, shall be fitted with hinged doors having combination lock and latch with locks keyed alike. A typewritten directory, properly identifying the circuits, shall be mounted in each frame. Panels shall be as scheduled on the Drawings.

B. Panelboards shall be surface or flush mounted with branch circuit breakers and main breaker or main lugs as indicated on the Drawings and/or specified herein.

C. Branch circuit breakers installed in the panels shall have a minimum short circuit rating as indicated on the drawings.

D. Provide Arc Flash labels in accordance with NFPA 70, Article 110.

2.5 RACEWAYS

A. Install wiring in electric metallic tubing (EMT), and or schedule 40 PVC. Schedule 40 PVC may be used outside only, raceways within the building shall be metal.

B. Raceways and wiring, except as otherwise noted, shall be installed exposed in unfinished areas such as electrical and mechanical rooms.

C. Electric metallic tubing shall not be installed in concrete on grade, in concrete in contact with earth or underground.

D. Buried rigid steel conduits (RSC) shall have two coats of bituminous protection.

E. Provide EMT for elevator feeders.

2.6 CONDUCTORS - WIRE AND CABLE

A. Branch circuit conductors installed in the building shall be type “MC” cable. Panel feeders may be type SER cable if permitted by local codes.

B. Conductor sizing shown on the Drawings is based on copper. Contractor can substitute aluminum of equal ampacity for all panel feeders and service conductors.

C. Joints and splices shall be made in a manner equivalent electrically and mechanically to the conductor itself.

D. Conductors shall be color coded - Phase A: black, Phase B: red, phase C: blue, Neutral: white, Ground: green.

E. Colors, except colors for conductors No. 4 and larger, shall be factory applied the entire length of the conductors by solid color compound, solid color coating or colored striping or bands, 2 sets 180 degree apart. On-site coloring shall not be done, except color coding by means of paint or tapes is acceptable only for conductors No. 4 and larger.

F. Voltage rating, manufacturers, type and conductor, AWG size indication shall be continuous, factory applied the entire length for each conductor.

G. Wire No. 8 AWG and larger shall be stranded. Wires smaller than No. 8 AWG shall be solid.

H. Minimum wire size is #12 AWG per MSHA standard.

2.7 WIRING DEVICES

A. Switches, receptacles and other utilization devices shall be specification grade, grounding type. Back and side wired. Color by Architect.

B. Receptacles and switches shall have a grounding pole and grounding terminal, which shall be connected to the outlet box with grounding conductor to establish grounding continuity.

C. Verify mounting height of devices prior to roughing.

2.8 WIRING DEVICE PLATES

A. Provide device plates for devices, switches, receptacles, and miscellaneous outlets.

B. Plates shall be high impact nylon to match the installed device. Color by Architect.

2.9 PULL BOXES AND JUNCTION BOXES

A. Pull boxes of code gauge galvanized steel with screw covers to match, shall be as required and shall be as shown on Contract Drawings.

B. Junction Boxes in Exterior walls shall be air vapor barrier box as manufactured by LESSCO or equal. Conductors passing through pull boxes shall be identified to indicate their origin and termination.

2.10 NAMEPLATES

A. Provide nameplates for panelboards, motor disconnect switches, and motor starters designating equipment controlled and function.

B. Nameplates shall be laminated plastic with engraved white letters. Letters shall be 1/4 inches high. Nameplates shall have identifying color background for each system.

2.11 OUTLETS

A. Outlets shall be centered in panels and spaces provided therefore. If any discrepancy is found to exist between outlets as shown on Electrical Drawings and Architectural Drawings notify Architect to have location verified prior to installation.

B. Verify power wiring with equipment wiring diagrams before wiring equipment. Disconnects and starters shall have nameplates indicating the loads they control.

2.12 LIGHTING FIXTURES AND LAMPS

A. Fixtures shall be by the manufacturers specified or as otherwise determined by the Architect.

B. Energy Saving Ballasts for fluorescent fixtures shall be Class P: high power factor; shall incorporate UL listed automatic resetting protection: shall be classified for quiet operation, "A" sound rating: shall be designed for a nominal 120 volt system as shown. Provide Program Start ballasts for occupancy controlled fixtures. Ballast Factor shall be .88 to 1.

C. Energy saving lamps of wattage, type and color indicated shall be furnished and installed in necessary quantity to completely lamp every fixture. Incandescent lamps installed in permanent lighting fixtures and used for lighting during construction shall be replaced on or just after the date of substantial completion.

D. Fixtures shall be complete with all accessories such as close nipples, extension couplings, connecting straps, screws, locknuts, hickies, plaster rings, to provide complete fixture installation for use with any type of standard outlet or switch box. Special fittings required to support fixtures shall be supplied as well as wood, or metal supports or grounds to support surface or pendant mounted fixtures.

2.13 FIRE ALARM SYSTEM: SUPERVISED

A. The fire alarm system shall consist of the fire alarm control panel, pull stations, horns and strobes, strobes only (ADA), smoke detectors, heat detectors. Furnish and install wire, cables, conduit and conduit fittings, wiring and wiring devices, junction boxes and outlet boxes, fire alarm boxes, fire detectors and control equipment and accessories indicated or specified herein for a complete fire detection installation. System shall be Notifier or equal.

B. The system shall be fully addressable, fully supervised fire alarm installed according to the drawings and specifications and in accordance with NFPA Codes 72 and local codes and the Portland Fire Department. Material shall be new, except as noted, first quality and the best of each class specified. Work shall be executed in a workmanlike manner and shall present a neat appearance when completed. Equipment shall be installed in accordance with the recommendations of the manufacturer and best standard practice for this type of work.

C. Require the manufacturer of the equipment to include the battery calculations for standby batteries. The furnishing of complete installation Drawings and Riser Diagram and connection diagrams and catalog cuts of components shall also be required of the manufacturer by the contractor.

D. Provide the services of the manufacturer of the equipment to supervise the installation, to adjust and test the system, to assure a complete and fully operative facility in accordance with the Specifications and to instruct designated personnel in the operation, adjustment, testing and maintenance of the system.

E. Notify the Architect, Owner and Portland Fire Department when the system is ready for final approval tests. The system shall be considered ready for such testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative. Two copies of the test report shall be submitted to the Owner.

F. Furnish and install a complete 24VDC closed circuit, electrically supervised, addressable, annunciated fire alarm system as specified herein and indicated on the drawings. The system shall include but not to be limited to all control equipment, power supplies, signal initiating devices, audible and visual alarm devices, conduit, wire, fittings and other accessories required to provide a complete and operable system. The system shall operate as a non-coded, continuous sounding system.

G. Provide and install required equipment and accessories necessary for the proper operation of the system.

H. Fire system equipment shall be labeled with the manufacturer's name and logo to assure the integration of the complete system.

I. Wiring for the fire alarm system shall be subject to the same restriction as herein before specified for light and power circuitry. (NEC Article 760) Raceways containing conductors shall not contain any other conductors and no A.C. conductors will be allowed in the same raceway with the D.C. fire alarm detection and signaling conductors. Plenum rated fire alarm cable may be used if allowed by the authority having jurisdiction.

J. Equipment shall be listed by Underwriters Laboratories, Inc. or approved by Factory Mutual or as accepted by the authority having jurisdiction. The catalog numbers specified are those of Notifier Fire Alarm Systems. The fire alarm system in its entirety shall be in compliance with all applicable fire and electrical codes and comply with the requirements of the local authority having jurisdiction over said systems.

K. General requirements as follows:

1. A riser diagram of the complete fire alarm system extension, (Typical riser diagrams are not acceptable).

2. A complete point-to-point installation diagram for the extension. (Typical wiring diagrams are not acceptable).

3. A complete list of current drain requirements during normal supervisory, trouble and alarm condition.

4. Battery standby calculations showing total standby power required to meet the specified system requirements.

L. The operation of any manual station or automatic activation of any smoke detector, or water flow device shall cause:

1. Fire alarm horns to sound in the building.

2. Evacuation lamps to flash in the building.

3. Automatically shut down fans and/or close doors to prevent the re-circulation of smoke.

4. Notify the Portland Fire Department via a Masterbox.

5. Elevator recall shall be initiated by activation of any elevator lobby smoke detector, the smoke detector in the Elevator Machine Room or the smoke detectors in the elevator shaft and pit. Elevator recall shall cause the elevator to go to the First Floor (Main Egress Level) or alternate floor if the First Floor detector is in alarm. Provide all programmable relay modules.

6. Operation of the 120 volt dual contact heat detector in the elevator Shaft, Elevator Pit or Elevator Machine Room shall cause the shunt trip on the elevator feeder breaker to trip and disconnect electric power to the disconnect switch prior to water flow from

the sprinkler system and initiate an alarm in the Elevator Zone of the Fire Alarm System. Provide programmable control relay modules.

7. Detectors for the Elevator shall be programmed separately from detectors throughout the building. Only elevator lobby smoke detectors will initiate special "Fire Service" elevator operation.

M. Each initiating circuit shall be represented on the zone cards in the control panel by an amber trouble LED and a red alarm LED. The LED's for each zone shall be identified on the control panel by custom lettering showing the zone designation. Circuit trouble shall be indicated by the amber LED. Audible trouble and alarm devices shall be supervised. Flashing lights to be supervised.

N. Each initiating circuit shall be electrically supervised for opens and ground faults in wiring, and for short circuit faults and shall be so arranged that a fault condition in any circuit or groups of circuits will not cause an alarm to be sounded. The occurrence of any fault will light a trouble LED and sound the sonalert but will not interfere with the proper operations of any circuit which does not have a fault condition.

O. The installer shall coordinate the installation of the fire alarm equipment with the manufacturer. Conductors and wiring shall be installed per the manufacturer's recommendations. It shall be the installer's responsibility to coordinate with the manufacturer the correct wiring procedures in accordance with the latest revisions of the appropriate NFPA pamphlets, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ). Pigtail connections between circuit wires and detector terminals are not acceptable. Devices shall be connected to the circuit line wires.

P. Guarantee equipment and wiring free from inherent mechanical and electrical defects for a period of one year from date of the final acceptance. Before the installations shall be considered completed and acceptable by the awarding authority, a test on the system shall be performed as follows: The contractor's job foreman, in the presence of a representative of the manufacturer, a representative of the owner, and the fire department shall operate the building annunciator and control panel. One half of all tests shall be performed on battery standby power. Where applying heat would destroy any detector, they may be manually operated. The initiating circuit and the signaling circuits shall be opened in at least two locations per zone to check for the presence of correct supervisory circuitry. When the testing has been completed to the satisfaction of both the contractors job foreman and the representatives of the manufacturer and owner, a notarized letter co-signed by each attesting to the satisfactory completion of said testing shall be forwarded to the owner and the fire department. The contractor shall leave the fire alarm system in proper working order and without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within one year from the date of final acceptance by the awarding authority. Prior to final test, the fire department must be notified within a reasonable time of test date (at least 24 hours). The contractor shall provide the necessary personnel and equipment to conduct the tests outlined above.

Q. Detection and signaling circuits shall be run separate from all other conductors. Wiring shall be number 14 solid.

R. Connection within the control equipment and devices shall be made with T and B "stakon" spade terminals. Wiring within the control equipment shall be secured with T and B "tyraps" and placed in wired gutters.

S. No fire panel shall have locked programming codes. Any qualified service professional must be able to reprogram the panel without needing assistance from the supplying vendor or manufacturer.

T. No fire panel shall contain parts or components that are not readily available from multiple competitive suppliers on the local market and the internet.

U. Part numbers specified are for Notifier. Fire alarm system components shall be as follows:

1. Fire alarm control panel: Notifier NFS-640 addressable panel, supply with all modules and relays for complete operational system. Supply with NFPA required battery back-up and charger located in electrical room. Provide digital alarm communicator transmitter and all associated telephone interface hardware. Shell contractor responsible for complete operational system.

2. System Smoke Detectors: Notifier FSP-751 low profile, intelligent, addressable photoelectric head with B710LP base - Provide quantity as shown on the plans and at least one over the fire alarm control panel and power extender modules for NFPA compliance. Smoke detectors within apartments shall be system connected but shall not trip the building fire alarm system.

3. Manual Pull Stations: Notifier NBG12LX - addressable, dual action, key reset station with integral LED visible from the front of the pull station that blinks when the pull station is addressed by the control panel.

4. Horn/Strobe Alarms: Notifier NS-24-MC-WFR series with adjustable candela settings and adjustable volume taps. Provide synchronized strobes in rooms where more than 2 strobes are visible within the same sightlines, provide Notifier DSM12/24R synchronization modules as required. Provide wire guards for gym horn/strobes. Provide the proper candela strobes for the room sizes as follows:

Room Size	Candela Rating
20' x 20'	15/75 cd
30' x 30'	30/75 cd
40' x 40'	75 cd
50' x 50’	110 cd

Use equivalent ratings for larger rooms per NFPA 72 Code.

5. Strobe Only Alarms: Notifier RSS-24-MC-WFR remote strobes with adjustable candela settings. Provide proper candela for each rooms as outlined above under horn/strobes. Provide wire guards for gym strobes.

6. Duct smoke detectors: Notifier for AHU in attic by manufacturer.

7. Heat detectors: Provide Notifier FST-751 (135 fixed temp) or FSD-751R (combination 135 fixed temp and rate of rise) heat detector heads with B-710LP addressable or HD-604 (200 fixed temp) wired to FMM-101 monitor module.

8. Sprinkler devices: Provide Notifier FMM-101 monitor module for each sprinkler alarm or tamper switch.

9. Control relay modules: Provide Notifier FRM-1 programmable relay modules as required to perform other specified or code required contacts to control other life safety alarm function in the building including elevator emergency signal light in cab.

10. Qty (2) Knox Box - #3270 recessed provided and installed by EC. Install where indicated and in accordance with the requirements of the City of Portland Fire Prevention Bureau.

11. Provide Single Station Smoke Detectors 120Volt with Battery Back Up and interconnected in units to all go into alarm simultaneously. Detectors shall be approved by the City of Portland. This system is independent of the supervised system.

12. Provide Single Station Carbon Monoxide Detectors 120Volt with Battery Back Up and interconnected in units to all go into alarm simultaneously. Detectors shall be approved by the City of Portland This system is independent of the supervised system. Provide as distinct alarm tone from the supervised or single station alarms.

V. Contractor shall supply and install radio fire alarm master box manufacturer by AES with antenna per City of Portland Fire Alarm Standards. Type of master box shall comply with City of Portland and be installed at the location specified by the Portland Fire Department.

2.14 MECHANICAL SYSTEM CONNECTIONS

A. Connect mechanical equipment as shown on the drawings. Control wiring shall be furnished and installed by the Mechanical Contractor.

2.15 APARTMENT INTERCOM/SECURITY SYSTEMS

A. Provide apartment intercom/security systems as shown on the drawings and specified herein.

B. The system described herein is a TEKTONE system (contact Norris, Inc.).

When a visitor presses a pushbutton on the Lobby panel a steady signal will sound in the apartment being called and the handicapped apartment visual signals will flash.

The tenant operates the "talk" button, then the "listen" button for 2-way voice conversation. Operation by the tenant of the door button will activate the door release in the lobby entrance

door. This door will also be unlocked by the Postal Lock Option which will give access to the postman.

C. System components (by TEKTONE or equal) shall be as follows (qty (2) master panels at two main entrees weather proof construction recessed):

1. SYSTEM - TEKTONE CM492.

2. Directory - TEKTONE AM 190D Button and speaker panel with postal lock option and pushbutton/directory panel with (43) buttons minimum, backbox and frame.

3. Apartment Intercom Panel - TEKTONE#IR204E (48" AFF in apartments per ADA).

4. Hearing Impaired Apartment Intercom Panel Lamp in the IBC Type A Units: LI404B strobe per manufacturer.

5. Frame, housing, amplifiers and transformers for complete system.

6. Qty (2) Lobby Door Strikes: By G.C. E.C. shall coordinate and wire. Lobby panel shall be medium bronze, mounted 48" AFF to top to comply with ADA requirements for wheelchair access.

D. Wiring shall be as required by the manufacturer. Wiring shall be run in raceways where exposed and shall be plenum rated if not run in raceway.

E. Coordinate the installation with the manufacturer. Secure detailed wiring diagrams from the manufacturer and to arrange for the manufacturer to supervise the installation and provide necessary instructions for use and maintenance to the Owner.

2.16 TELEPHONE/DATA

A. Provide and install telephone backboard in electrical room and each floor. Twisted pair cabling inside building and phone/data or phone only jacks where indicated on the drawings. Punch down blocks, etc. for an operational system.

B. 4" PVC conduit from roof down through all floors to telephone backboard with pull string. (Entrance cable by Telephone Company). Each apartment to have (2) separate lines.

C. Telephone equipment (phones, processors, etc.) by others.

D. Provide CAT 5E cable, jacks, plates, terminations and testing for complete operational system. All cables shall be run to electrical room tel backboard.

2.17 CABLE TELEVISION

A. Provide and install cabling, jacks and plates inside building where indicated on drawings. Cabling layout on each fllor shall go back to closest com closet. Cabling shall terminate on in comm closets and main electrical rooms. Coordinate with Time Warner cable. All cable and jacks interior to the building by contractor. Comm closets provided on each floor.

2.18 EMERGENCY GENERATOR AND AUTOMATIC TRANSFER SWITCH

A. General: Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator. PMG Excitation and 100% rated output circuit breaker.

1. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

2. The generator set manufacturer shall warrant the equipment provided under this section, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator set and transfer switch.

3. Generator set Control. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

4. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

B. The generator set mounted control shall include the following features and functions:

1. Control Switches:

a. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

b. Emergency Stop Switch: Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

c. Reset Switch: The reset switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

d. Panel Lamp Switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time. Provide LED lamps.

C. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

4. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

D. Generator Set Alarm and Status Display: The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:

1. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).

2. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.

3. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.

4. The control shall include an amber common warning indication lamp.

E. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:

low oil pressure (warning)
low oil pressure (shutdown)
oil pressure sender failure (warning)
low coolant temperature (warning)
high coolant temperature (warning)
high coolant temperature (shutdown)
high oil temperature (warning)
engine temp sender failure (warning)
low coolant level (warning)
fail to crank (shutdown)

fail to start/overcrank (shutdown)
overspeed (shutdown)
low DC voltage (warning)
high DC voltage (warning)
weak battery (warning)
low fuel-daytank (warning)
high AC voltage (shutdown)
low AC voltage (shutdown)
under frequency (shutdown)
over current (warning)
over current (shutdown)
short circuit (shutdown)
over load (warning)
emergency stop (shutdown)
(4) configurable conditions

F. Provisions shall be made for indication of three customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

G. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

H. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

I. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

J. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

K. Outdoor weather-protective housing: factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

L. Transfer switches as shown on the drawings shall be equipped with accessories as follows:

1. Meters: Provide an AC Voltmeter, an Ammeter, and a Frequency meter; 2.5 inch, analog, 2% accuracy. Provide a phase selector switch to read L-L voltage and current of both power sources.

2. Exerciser Clock: Provide solid-state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.

3. Battery Charger: Provide a float charge battery charger rated 10 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and fused DC output. Include fault indications and Form C contact for AC Fail, High Battery Voltage, and Low battery Voltage.

4. Battery Charger: Provide a float charge battery charger rated 2 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and DC outputs.

5. Manual Selector Switch: Provide a manual/automatic retransfer selector switch to provide either automatic retransfer after the retransfer time delay, or a manual retransfer when selected by an operator.

6. Load Shed: Provide a load shed relay, to move the transfer switch from the emergency position to a neutral position, on receipt of a signal from a remote device.

7. Signal Module: Provide signal module, to delay the transfer and retransfer of the switch for up to 50 seconds to provide a pretransfer warning signal contact. Provide signals for the following conditions:

   -- source 1 available
   -- source 2 available
   -- test/exercise
   -- backup source available

   Contacts for these functions are to be form C type, rated for 120 VAC or 30 VDC at 4 amps.

8. Phase Sequence Monitor/Balance Module: Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.

9. Interconnect transfer switch and Elevator Controls with 2-#14AWG in ½" EMT. Coordinate work with Elevator installer. Do the same with a connection between the Shunt Trip Control Power for the elevator and the Fire Alarm Control Panel and the elevator tamper switch.

M. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for

specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.

2.19 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)

A. Main service and distribution equipment suppressors: Combination Surge and Lighting Arrestor. The AC voltage SPD's shall be a high speed, high current device designed to protect electrical systems and electronic equipment from transient over-voltage. The SPD shall provide continuous bi-polar, bi-directional, non-interrupting protection and be capable of instant reset with no degradation in protection. Gas tubes are not acceptable. The SPD shall utilize SAD or Selenium Based MOV technology. It shall start to suppress at a minimum of 115% of the peak voltage of the sine wave. At maximum surge current dissipation, the device shall not exceed the maximum voltage protection level. The SPD shall be installed in parallel with the service main disconnect, distribution or branch panel main lugs as shown. Connect SPD to over current protection sized as shown with an AIC rating equal to panel rating. The suppressor shall have status indicator lights, dry contacts with remote alarm capabilities and an audible alarm. Suppressors shall be assembled as modular units to permit quick, easy replacement of failed components. The product shall Comply with UL 96, UL 1449 and ANSI/IEEE 62.34.

1. Electrical Service:

    a. Voltage shall be as indicated on drawings.
    b. Frequency -- 50/60 Hz
    c. Phases -- 3 phase
    d. Wiring configuration -- as indicated

2. IEEE 62.41 Categories unless otherwise indicated on drawings:

    a. Service entrance sizes
    b. 600A B3/C1
    c. > 600A to 1.2 KA C2
    d. > 1.2 KA C3
    e. Distribution or sub-panels B2

3. Electrical Performance:

    a. Response time < 5 nanoseconds
    b. MCOV 115% minimum
    c. Shortwave test- surge current
    d. (6kv, 1.2/50usec; 3ka 8/20µsec) 5000 surges

4. Minimum surge current:

    a. Service Entrance 410,000 Amps/Phase
    b. Distribution and Sub-panels 210,000 Amps/Phase (No Unit Panelboards)

5. Suppression system protected modes shall be L-N, L-G, N-G for Wye Systems and L-L, L-G for ungrounded Delta Systems.

6. Power on indicators and failure detection: A lighted panel on the cover shall provide indication that the suppressor is properly activated and shall also indicate mode failure. If the suppressor fails, an isolated contact shall close. In addition, an audible alarm shall be provided with manual reset.

7. Failure mode - SPD's shall be designed to fail shorted. Any fuses in series with the SPD's shall not open during a surge event.

B. Disconnect: Main service suppressors shall be provided with an integral fused disconnect switch or dedicated circuit breaker as shown or required by UL. Breakers and suppressors shall have an AIC fault withstand rating equal or greater than the AIC rating of the equipment to which it is connected. The length of wiring from the tap at the service conductors to the suppressor being protected, however, shall not exceed the maximum length permitted by manufacturer, to maintain the maximum voltage protection level. Suppressors may be installed within switchgear or panel boards where UL label or listing is not affected, suppressors are completely and easily accessible, indicator lights are visible and audible alarm can be easily heard.

C. Enclosures: Enclosures for main service suppressors shall be as follows;

1. Minimum, 14 gauge painted steel or suitable enclosure to meet the NEMA selected requirements as listed.

D. Operation Status Indicator: Audible Remote Signaling and Visual Systems:

1. Visual System:

a. Protection: Suppressor Working - Green LED's
b. Warning/Fault: Suppressor Failure - Red LED's
c. LED's shall be field replaceable
d. Other visual indicators where approved.

2. Remote Signaling: Relay with Auxiliary for C contacts: Two sets @ 2 ampere, 120 volts each. 1 Set N.O. and 1 set N.C. to operate upon failure of suppression module, blown fuse or tripped circuit breaker in suppressor module or in disconnect switch for alarm connection to remote location

3. Audible: The audible alarm shall activate upon a fault condition within the suppressor. An alarm silence/reset switch and push-to-test switch shall be provided.

E. Bonding and Grounding Conductors and Materials for Main Service Suppressors:

1. Size: Conductors utilized for surge suppressor connections to service conductors shall be a minimum of #6 AWG stranded insulated copper unless otherwise specified.

2. Bus: Ground bus or strip material where used shall be copper, a minimum of ¼ inch thickness and two inches wide unless otherwise specified. Bus materials shall be secured to surfaces with appropriate insulators and mechanical fasteners. Bus connections shall be bolted and reinforced as necessary to provide a permanent and secure connection.

3. Connections Compliance: Connectors, splices, and other fitting used to interconnect grounding conductors, bonding to equipment or ground bars, shall comply with

requirements of the National Electric Code and be accepted by Underwriters' Laboratories for the purpose.

4. Connectors: Connectors and fitting for grounding and bonding conductors shall be of the compression type in above grade locations. Connections below grade shall be exothermically welded.

5. Dissimilar Materials: Bonding connections between electrically dissimilar metals shall be made using exothermic welds or using bi-metal connectors designed to prevent galvanic corrosion.

2.20 ENCLOSED DISCONNECTS

A. Disconnect Switches:

1. Acceptable Manufacturers

a. Square D
b. Westinghouse
c. Eaton (CH)
d. General Electric

2. Fusible Switch Assemblies: NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R or J fuses as applicable.

3. Non-Fusible Switch Assemblies: NEMA KS 1; Type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

4. Enclosures: NEMA KS 1; as indicated on Drawings. Provide labels for all disconnects describing loads served. Provide Arc Flash labels in accordance with NFPA 70, Article 110.

B. Fuses:

1. Manufacturers:

a. Buss
b. Chase Shawmut
c. Cooper

2. Fuses 600 Amperes and Less: ANSI/UL 198C, Class J; ANSI/UL 198E, Class RK1; RK5; dual element, current limiting, time delay, one-time fuse, 250 or 600 volt as indicated or required.

3. Interrupting Rating: 200,000 rms amperes.

4. Provide spare fuses as indicated.

2.21 MOTOR STARTERS

A. Combination Reduced-Voltage Solid-State Controller: Factory-assembled combination of reduced-voltage solid-state controller, OCPD, and disconnecting means.

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

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Main Distribution: Service Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
d. N.C. alarm contact that operates only when MCP has tripped.
e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

B. Enclosures:

1. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

a. Dry and Clean Indoor Locations: Type 1.
b. Outdoor Locations: Type 3R.
c. Kitchen Areas: Type 4X.
d. Other Wet or Damp Indoor Locations: Type 4.

C. Accessories:

1. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

a. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty type.

1) Push Buttons: Recessed type; maintained as indicated.
2) Pilot Lights: LED type; colors as indicated.
3) Selector Switches: Rotary type.

b. Elapsed Time Meters: Heavy duty with digital readout in hours; non-resettable.

c. Meters: Panel type, 2 ½" minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

2. Reversible N.C./N.O. auxiliary contact(s).

3. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

4. Phase-Failure, Phase-Reversal, and Under-voltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable under-voltage, overvoltage, and time-delay settings.

5. Cover gaskets for Type 1 enclosures.

2.22 MODULAR METER CENTERS

Provide modular meter centers as indicated on the drawings:
Three Phase in and Single Phase out. (120/208 volts)
Buss Amperes as indicated
5 Jaw Meter Socket – 125A each
Main circuit breakers and current transformer cabinet as shown on drawings.
Overcurrent devices with AIC ratings as indicated.
Square D EZM series or equal.
House Meter
Coordinate work with the utility

PART 3 EXECUTION

3.1 LICENSE

A. Electrical work shall be installed by persons duly licensed by the Electricians Board of the State of Maine.

3.2 COORDINATION

A. It shall be the responsibility of this contractor to coordinate his work with other trades to insure that his work is terminated is a satisfactory manner.

3.3 WORKMANSHIP AND PREPARATION

A. Work shall be executed in a workmanlike manner by experienced electricians in accordance with the most modern engineering practice and shall present a neat appearance when completed. The work shall be carefully laid out in advance and where cutting, channeling, chasing, or drilling of floors, walls, partitions, and ceiling or other surfaces is necessary for the proper installation, support or anchorage of the conduit, raceways or other electrical work, this work shall be carefully done and any damage to the building, piping or equipment shall be repaired by skilled mechanics of the trades involved and at no additional cost to the Owner.

B. After installation, electrical equipment shall be protected to prevent damage during the construction period. Openings in conduits and boxes shall be closed to prevent entrance of

foreign materials. The interior of boxes and cabinets shall be left clean, exposed surfaces shall be cleaned and plated surfaces polished.

3.4 OBTAINING INFORMATION

A. Obtain information from the manufacturers of the apparatus which is to be provided for the proper methods of installation. Also obtain information from the General Contractor and other Sub-Contractor which may be necessary to facilitate work and the completion of the whole project.

3.5 PROVIDING INFORMATION

A. The Contractor shall keep himself fully informed as to the shape, size and position of openings and foundations required for his apparatus and shall give full information to the General Contractor sufficiently in advance of the work so that such openings and foundation may be built in advance. Also furnish supports herein specified so the General Contractor may build same in place. In the case of a failure on the part of the Contractor to give proper information as noted above, he shall assume the cost of having the work done.

3.6 RACEWAYS

A. Raceways, where applicable, shall be supported and secured at intervals of not more than 10 ft. with minimum of two supports shall be provided if required. Tie wire or perforated metal straps shall not be used to support or secure raceways or other equipment. Electric metallic tubing shall be supported within 18: of each coupling or connector. In finished areas, furnish and install escutcheons for exposed conduit passing through or entering finished floors or walls.

B. Expansion coupling shall be provided in each raceway crossing building expansion joint and when length of raceway requires expansion coupling, expansion coupling shall have a total minimum expansion of 4" and shall have a flexible bonding conductor. Setting of expansion coupling shall be a function of the temperature at the time of installation. Flexible couplings shall be provided where required.

C. Raceways shall have runs installed parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings. Field-made bends and offsets shall be avoided where possible, but where necessary, shall be made within an approved hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways shall be avoided. Care shall be taken to prevent the lodgement of plaster, dirt or trash in raceway boxes, fittings and equipment during the construction. Clogged raceways shall be entirely free of obstructions or shall be replaced. Wooden plugs inserted in concrete or masonry are not acceptable as a base for raceway fastenings nor shall raceways or pipe straps be welded to steel structures. Raceways shall be secured by pipe straps or shall be supported by wall brackets, strap hangers or ceiling trapeze fastened by wood screws on wood, toggle bolts on hollow units, expansion bolts on concrete or brick and machine screws or welded studs on steel work.

3.7 OUTLETS

A. Each outlet in the wiring or raceway systems shall be provided with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of the National Electrical Code. Boxes shall not be less than 1-1/2" deep unless shallower boxes are required by structural conditions and are specifically approved.

B. Ceiling and bracket outlet boxes shall be not less than 4" except that smaller boxes may be used where required by the particular fixture to be installed. Boxes shall be installed in a rigid and satisfactory manner and shall be fastened directly with wood screws on wood, bolts and expansion shield on concrete or brick, toggle bolts on hollow masonry units and machine screws or welded threaded studs on steel work.

3.8 FIXTURES

A. Incandescent and fluorescent fixtures shall be supported by building structural elements independent of furred or suspended ceilings.

B. Subsequent to review of shop drawings and prior to ordering fixtures, verify voltage at each fixture, also consult with others to determine the type of ceiling and ceiling suspension system in each and every room and order fixtures to suit and fit the particular ceiling and ceiling suspension system. Any extra costs because of failure on the part of this Contractor to verify voltage or ceiling requirements shall be paid for by this Contractor. It is not the intent of fixture catalog numbers shown to classify the voltage, ceiling or ceiling suspension.

3.9 WIRING DEVICES

A. Switches and convenience outlets shall have a rating as indicated on the drawings. Light switches shall be silent type. Outlets connected to exposed conduits shall be installed in a surface mounted, conduit device box, 4-1/2" long by 2-1/8" wide and with a suitable cover for the device to be installed (box shall be galvanized). Plates on finished walls and on boxes connected to concealed cable and conduits shall be as noted in the specifications.

3.10 INTENT OF DRAWINGS

A. It is not intended that the drawings show in detail every conduit, junction box, etc., but material necessary to complete the electrical system in accordance with the best practices of the trade and to the complete satisfaction of the Architect, shall be furnished without additional recompense under this section of the specifications. No deviation from the layout shall be made without written approval from the Architect.

3.11 GROUND RESISTANCE TEST REPORT

A. Use IEEE 81-1983 for industry standard three point or fall of potential test
B. No current shall be flowing on the ground
C. The furthest test probe (C2) must go out at least 3-5 times the size of the system or a minimum of 100’ in at least two directions.
D. Use a ground test instrument specifically designed for electrical ground testing
E. Instrument shall be calibrated within the past 12 (twelve) months The report shall consist of the following:

1. Provide: A sketch showing building/structure and test directions & distances
2. Model of Test instrument
3. Serial number of the test instrument
4. Proof of calibration within the past year (Test Certification or paid invoice)
5. Date of test
6. Test readings at 52%, 62%, 72% of the C2 distances

If the average of the 62% values of the tests exceeds the 25-ohm value for power systems or 5-10 ohms for low voltage systems or static grounding systems, the engineer shall be informed immediately.

A "Megger" ground probe may also be used to determine the system resistance. Disregard low readings where the conductors are "looped". The utility neutral shall be disconnected for any test to eliminate stray currents.

3.12 GENERATOR SYSTEM PRE-START AND RUN PROCEDURES

A. Field Tests:

1. Perform The Following Tests/Inspections And This Submit Check List To Engineer.
   (a) Oil System
      1) Add Engine Lube Oil And Check Level.
      2) Service Air Cleaner
      3) Oil Filter
      4) Governor Linkage

   (b) Fuel System
      1) Natural Gas
      2) Manual Shut Off Valve
      3) Primary Gas Pressure Regulator
      4) Dry Fuel Strainer
      5) Gas Solenoid Valve
      6) Flexible Fuel Connection
      7) Gas Available

   (c) Exhaust System
      1) Seamless Tubing
      2) Exhaust Condensation Trap
      3) Muffler
      4) Correct Exhaust Pipe Sizing
      5) Long Radius Exhaust Elbows
      6) Exhaust Thimble

   (d) Cooling System
      1) Radiator Cooling
      2) Add Coolant, Anti-Freeze And Check Level
      3) Proper Exhaust Ventilation Duct And Opening (If Applicable)
      4) Proper Inlet Ventilation Opening
      5) Proper Air Circulation

   (e) Mounting
      1) Secured To Level Surface

2) Oil Drainage Clearance
3) Vibration Isolators Installed Correctly

(f) Engine
1) Spark Plugs
2) Choke Set For Fuel Used
3) Breaker Point Set
4) Inspect Belt, Fan, Alternator, And Governor

(g) Battery
1) Proper Battery Size
2) Electrolyte
3) Correct Polarity
4) Isolation From Floor

(h) Electrical
1) Engine Water Jacket Heater Wired To Normal Source (If Required)
2) Fuel Solenoid Valve Wired To Ignition System
3) Remote Start Wiring To Transfer Switch
4) Operation Selection Switch To Proper Position
5) Proper Generator A. C. Wiring Connections
6) Is Plant Grounded?
7) Where?

2. Automatic Load Transfer Switch
(a) Remote Start Wiring To Engine/Generator
(b) Trickle Charge Operation And Adjustment
(c) Proper A. C. Load, A. C. Generator And A. C. Normal Wiring
(d) Adjust Time Delay Relays
(e) Adjust Clock Exerciser
(f) Visual Check Of Main Contactors
(g) Check Annunciator If Applicable

3. General Inspection
(a) Wiring
(b) Hoses
(c) Clearances
(d) Supports

4. Start And Warm Up Period (No Load)
(a) Field Circuit Breaker Off
(b) Start Engine (Selection Switch In "Run" Position)
(c) Oil Pressure Lbs.
(d) Water Temperature °F
(e) Battery Charge Rate
(f) Unusual Noises / Vibrations
(g) Field Circuit Breaker "On"
(h) Check Phase Rotation
(i) Voltage
(j) Hertz
(k) Allow Proper "No Load" Warning

5. a)Warm Up Period (Add Load)
   (a) Selection Switch In "Run" Position
   (b) Add Load By Simulating Power Failure (Main Breaker Or Test Switch In The Automatic Transfer Switch)

6. Engine/Generator
   (a) Carburetor Adjustments
   (b) Governor Adjustments
   (c) Check For Overload
   (d) Actual Load Test
      1) Load Per Leg Amps Amps Amps
      2) Voltage
      3) Hertz
      4) Oil Pressure Lbs.
      5) Water Temperature °F
      6) Check Low Oil Pressure Safety Switch
      7) Check High Water Temperature Safety Switch
      8) Check Engine Overspeed Safety Switch
      9) Unusual Noises / Vibrations

   (e) Automatic Load Transfer Switch
      1) Transfer To Emergency Ok
      2) Time Delays Timed Out Ok
      3) Remove Load (Main Breaker Or Test Switch In The Automatic Load Transfer Switch)
      4) Retransfer To Normal Ok
      5) Shut Down Plant (Selection Switch In "Stop" Position)

   (f) Complete Automatic Restart Period
      1) Check Oil And Water Levels
      2) Selector Switch In "Remote"
      3) Simulate Power Failure (Main Breaker Disconnect)

B. Engine Generator
   1. Engine Start Ok
   2. Engine And Generator Under Load Ok
   3. Unusual Noises / Vibrations

C. Automatic Load Transfer
   1. Transfer To Emergency Ok
   2. Return Load To Normal (Main Breaker "On" To Restore Line Power Transfer Switch)
   3. Retransfer To Normal Ok
   4. Time Delays Timed Out Properly
   5. Engine Shutdown Ok

D. Final Installation Recommendations

E. Manufacturer's Warranty Initiation

   1. Engine/Generator Date:

2. Automatic Load Transfer Switch Date:

F. Checkout And Initial Startup

1. Performed By

2. Performed By

3. Witnessed By

3.11 RECORD DRAWINGS

A. During the progress of the work, keep a set of drawings marked up to record deviations and changes from the Contract Drawings due to field conditions, change orders, amendments, revisions, addenda and other reasons to represent an accurate record of all work as actually installed. Include an accurate layout of all in-slab, under-slab, and buried conduits.

B. Deviations from the Contract Documents shall be approved by the Architect before installation.

C. At the completion of the work, furnish to the Architect a complete set of prints of the original Contract Drawings on polyester film, corrected in a neat manner to reflect all the above changes and representing an accurate record of all work as actually installed.

D. The record drawings shall be submitted to the Architect for approval and corrected as deemed necessary.

E. After approval, the record drawings shall become the property of the Owner.

3.12 INSTRUCTIONS, OPERATION AND MAINTENANCE DATA

A. A the completion of the work, turn over to the Owner, one (1) set of operating and maintenance instructions of equipment and systems. Submit name and address of nearest available source of repair service and replacement equipment and parts to the Owner and Architect. Explain and demonstrate the operation of the fire alarm system and the apartment intercom/security system to the Owner's representative. The manufacturer's field technician shall be present at this demonstration.

B. Arrange data in complete sets, properly indexed and marked.

C. Data shall include a complete set of shop drawings.

D. Material shall first be submitted in preliminary form for review by the Architect. After review, submit two (2) copies in bound volumes to the Architect for distribution.

END OF SECTION