

SECTION 16000 - ELECTRICAL

PART 1 - GENERAL

1.01 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. New underground electrical service for power and telephone.
2. Secondary power distribution.
3. Lighting system - interior and exterior.
4. Fire alarm System
5. Connections, disconnects and starters as shown for mechanical equipment.
6. Exit and emergency lighting.
7. Conduits and boxes for computers and telephone.
8. Security System by others.
9. Coordinate bank equipment power/data connections with bank equipment supplier.
10. Coordinate installation of pneumatic teller machine with Portland Safe Company.

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

- B. Assume responsibility to have thoroughly examined the drawings and specifications including addenda. Questions over any conflicting information shown on the drawings and specifications shall be referred to the Architect for clarification.
- C. The term "Contractor used hereinafter shall designate the Electrical Contractor.

1.02 RELATED DOCUMENTS

- A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work. Read these to become familiar with conditions related to the installation of the work.

1.03 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 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. Institute of Electrical and Electronic Engineers (IEEE)

3. National Electrical Manufacturers Associations (NEMA)
4. National Fire Codes
5. Underwriters Laboratories, Inc. (UL)
6. Federal, State and Municipal Building Codes, and all other Authorities having jurisdiction.
7. National Electrical Code (NEC)
8. Insulated Power Cable Engineers Associated Specification (IPCES)
9. American Society for Testing Materials Specifications (ASTM)
10. National Bureau of Standards Handbook (NBS)
11. Occupational Safety and Health Administration (OSHA)
12. National Electrical Safety Code (NESC)
13. Americans with Disabilities Act (ADA)

1.04 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.

1.05 SHOP DRAWINGS

- A. Submit to the Architect for review, not less than eight (5) sets of Shop Drawings of the materials, lighting fixtures, lamps and ballasts and equipment: Panelboards, Circuit Breakers, Disconnects, Motor Starters 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. switchgear, panels, lighting, fire alarm, security system, wiring devices, wire and starters/disconnects.. The cover page of each group shall be typewritten and contain the following information:
 1. Project location.
 2. Electrical Contractor and phone number.
 3. Product manufacturer and phone number.

4. Distributor or supplier's company and phone number.
 5. Order date and distributor order number.
 6. Approximate on-site delivery date after submittal review and return.
- 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.
- E. Shop drawings shall be submitted to the Architect no later than 14 days after award of General Contract.

1.06 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. Any substituted system must show a direct comparison to the system specified and all deviations from the specified system clearly identified. In all cases, the suitability of any substituted item or system shall be determined by the Architect/Engineer. If the substituted item or system is rejected, the item or systems specified shall be furnished and installed at no additional cost to the Owner.

1.07 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. Inspect the site and survey the conditions to be encountered in the performance of the Work prior to starting the work. Failure to be familiar with the conditions shall not relieve or reduce responsibility for full completion of the work in accordance with the provisions of the contract.

1.08 TEMPORARY LIGHT AND POWER

- A. Temporary light and power shall be installed and maintained under this contract for use by all trades for the duration of construction complete with wiring, switches, protective devices and similar equipment as may be required. Power bills shall be paid by the General Contractor. Temporary lights and power shall be completely removed no later than project completion. . Provide 120/240 volt 100 ampere, drop box similar to standard CMP detail 980-31.1.4. Provide 150 watt long life, rough service, frosted Type A lamps with plastic "cages".

1.09 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.

1.10 GUARANTEE

- A. 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.

1.11 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 any cause until the work is accepted by the Owner.

1.12 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.

1.13 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.

1.14 WORK UNDER OTHER SECTIONS

- A. Painting.
- B. Cutting and patching.
- C. Trenching and backfill.

PART 2 - PRODUCTS

2.01 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 or 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.

2.02 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. 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.
- D. 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.
- E. Supports shall be installed in a neat and workmanlike manner, perpendicular or parallel to walls, floor, columns, beams or ceilings.
- F. Attachment to structural steel shall be bolted type.

2.03 GROUNDING

- A. Furnish and install grounding system conforming to IEEE Std. 142-1982 and as required by codes or standards.
- B. Feeder, sub-feeders, lighting branch circuits and receptacle branch circuits shall contain a grounding conductor, minimum No. 12 copper with green insulation or as required by NFPA 70-250.
- C. Grounding terminal on receptacles and switches shall be bonded to outlet box with grounding conductor to establish grounding continuity.
- D. Flexible metal conduit and electric metallic tubing feeder raceways shall include grounding conductor.
- E. Grounding conductors shall be solid copper wire with THWN green color insulation.
- F. Grounding bushings shall be provided for raceways where required. Other raceways shall be insulating bushings.

2.04 PANELBOARDS

- A. Panelboards shall be Square D or equal, bolt-on breaker type with copper buses, hinged trim cover only. Panelboards shall include hinged doors for panel interior access as well as circuit breaker access. Panelboard cabinets shall be of the dead-front or 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 shall be mounted so that the distance from the floor to center of the top main circuit breaker (top feed) will not exceed 6'. 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 bolt-in 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. Provide Bolt On breakers.
- D. Provide arc flash labels for panelboards in compliance with NFPA 70, Article 110.

2.05 RACEWAYS

- A. Install wiring in hot dipped galvanized or sheradized threaded rigid steel conduit (RSC), and electric metallic tubing (EMT). Fittings shall be steel set screw type for EMT.
- B. Raceways and wiring, except as otherwise noted, shall be installed concealed in hung or furred ceilings, concrete slabs, masonry walls and partitions. Raceways may be exposed in unfinished areas such as electric, storage and boiler rooms.
- C. Electric metallic tubing shall not be installed in concrete on grade, in concrete in contact with earth or underground.
- D. Connections to portable equipment junction boxes and conduit termination to motors shall be made with liquid-tight flexible metal conduit, finished black or grey to match equipment. Flexible connections shall be maximum of 18" long with grounding conductor.
- E. Magnetic conduit used with power wiring shall be bonded to provide an effective ground. In addition to this, equipment grounding conductors shall also be installed in raceways.
- F. Run flexible metallic conduit to equipment with motors or equipment requiring alignment or movement and to sound generating equipment. Use liquidtight flexible metallic conduit in areas such as outdoor equipment or where subject to moisture.

2.06 CONDUCTORS - WIRE AND CABLE

- A. Conductors installed in raceway shall be insulated type THWN, 600 volt service, copper, within building and for transformer secondaries. Such wiring shall be color coded. Conductors with higher insulation temperature rating shall be provided as required.
- B. Conductor and conduit sizes shown on the Drawings are based on copper conductors with THWN insulation, unless otherwise noted.
- C. Joints and splices shall be made in manner equivalent electrically and mechanically to the conductor itself. Connections shall be of the compression type.

- D. Equipment requiring electric service is shown on Drawings or schedules. Where receptacles or convenience outlets are specified to service named equipment, furnish, install and connect approved flexible cable and cap to equipment.
- E. Drawings, in general, indicate required number of conductors in each raceway, however, unless it is specifically noted that raceways are empty by the word "empty" provide required conductors, power, control, supervisory, alarm or branch circuits. Make final connections, flexible or fixed as required to equipment shown requiring final electrical connections.
- F. Conductors shall be color coded. Branch circuits and feeders shall be color coded as follows:

120/208 Volts, 3 Phase, 4 Wire	
Black	Phase A
Red	Phase B
Blue	Phase C
White	Neutral
Green	Grounding

- G. 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.
- H. Voltage rating, manufacturers, type and conductor, AWG size indication shall be continuous, factory applied the entire length for each conductor.
- I. Branch circuit conductors shall be connected to separate line of supply mains to assure balanced condition in the circuit and proper load balance on panel.
- J. Wires, conductors and cables shall be single conductor, except as otherwise specified or indicated on Drawings. Wire No. 8 AWG and larger shall be stranded. Wires smaller than No. 8 AWG shall be solid.
- K. **All cable shall be type MC.**

2.07 WIRING DEVICES

- A. Switches, receptacles and other utilization devices shall be specification grade, back and side wired. Switches shall have a minimum rating of 20 amperes. Mercury switches will not be accepted.
- 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. Green grounding screw shall be used for grounding.
- C. Wiring devices shall be Hubbell or equal color ivory.
- D. Verify mounting height of devices prior to roughing.

2.08 WIRING DEVICE PLATES

- A. Provide device plates for devices, switches, receptacles, and miscellaneous outlets.
- B. Plates shall be ivory plastic to match the device installed.

2.09 PULL BOXES AND OUTLET BOXES

- A. Pull boxes and junction boxes shall be of code gauge galvanized steel with screw covers to match, shall be as required and shall be as shown on Contractor Drawings and have capacity as required by NEC.
- B. Conductors passing through pull boxes shall be identified to indicate their origin and termination.
- C. Pull and junction boxes and covers shall be for indoor use, except provide other types as required because of location.
- D. Covers shall not be installed until installation has been observed. Provide nameplate on cover: example: Feeder-Panel LPN.

2.10 NAMEPLATES

- A. Provide nameplates for panelboards, pull boxes, junction boxes, motor disconnect switches, and motor starters designating equipment controlled and function. Empty raceways shall be labeled.
- 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.
- C. Nameplates shall be secured by means of phillips head screws or rivets, adhesive shall not be used. Other types of nameplate identification shall not be acceptable.
- D. Provide arc flash labels on disconnects, panelboards and service equipment per NFPA 70-110.16.

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. Where outlets of any system occur provide suitable boxes and conduit so that they may be built in as the work progresses. Box offsets shall be made at outlets to provide proper adjustment to structural finish.
- C. Verify power wiring with equipment wiring diagrams before wiring equipment. Disconnects for motors shall be lockable if beyond 50 feet of motor or out of sight of the motor. Disconnects and starters shall have nameplates indicating the loads they control. Flush

mounted exhaust fan switches in finished areas shall have stainless plates with nameplates and pilot lights.

- D. Install nameplates on starters and disconnects furnished with equipment.
- E. Wire special equipment per manufacturer's wiring instruction and furnish disconnect switch as shown.

2.12 LIGHTING FIXTURES AND LAMPS

- A. Fixtures shall be the manufacturers specified in the Lighting Fixture Schedule.
- B. Energy Saving Ballasts for fluorescent fixtures shall be Class P electronic: 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. Interchangeability of lamps and ballasts shall be provided. Ballasts shall be designed, manufactured, and tested to meet the latest UL and ANSI standards and this requirement shall be certified by an independent testing organization. In addition to internal integral protection, each ballast shall have separate exterior fuse protection. Fixtures shall contain fuse and fuse holder, sized as recommended by manufacturer, mounted in ballasts compartment. Fuse shall provide rapid interruption of short circuits or ground fault current within fixture or ballasts. Fuse holder shall be similar to Bussman HLR with GLR quick blow fuse, Chase Shawmut, or acceptable substitute. Fuse protection shall be provided for each type of ballast. Ballast shall be rated for 10% THD.
- 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. Incandescent lamps shall be 130 volt, extended service type.
- 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 of pendant mounted fixtures on suspended ceilings.
- E. Submit Information on Fixtures, Lamps and Ballasts.

2.13 FIRE ALARM SYSTEM

- A. The fire alarm system shall consist of system connected pull stations, horns and strobes, strobes only, heat and smoke 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. The system shall be low voltage as manufactured by Notifier. Contact Norris Inc. - Brad Norris @ (800)370-FIRE - Notifier NESCO affiliate, or APPROVED equal.

- B. The system shall be complete with 60 hours of rechargeable pure lead battery standby, remote alarm and trouble indication, city connection and ground detection. The system shall be a closed circuit, non-coded, fully supervised fire alarm installed according to the drawings and specifications and in accordance with NFPA Code 72 and local codes and the Portland Fire Department. Material shall be new, 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 selection of the proper type and size of stand by 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 this 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 the 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, zone annunciated or combination addressable 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 which shall have multiple or zoned audible alarm circuits as specified and indicated on the drawings.
- 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 hereinbefore specified for light and power circuitry. (NEC Article 760) Raceways containing conductors shall not contain any other conductors and no A.C. carrying conductors will be allowed in the same raceway with the D.C. fire alarm detection and signaling conductors. Raceways containing fire alarm wiring shall be painted red, including junction boxes. Fire alarm cable not run in raceways shall be plenum rated fire alarm cable.
- J. Equipment shall be listed by Underwriters Laboratories, Inc. and approved by Factory Mutual or as accepted by the authority having jurisdiction. The catalog numbers specified are those of The Notifier Company. 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 from the manufacturer shall be as follows:
1. A riser diagram of the complete fire alarm system, (Typical riser diagrams are not acceptable).
 2. A complete point-to-point installation diagram. (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 or heat detector, or water flow device shall cause:
1. Fire alarm horns to sound in building.
 2. Evacuation strobes to flash in the building.
 3. Notification to the Portland Fire Department via the digital alarm communicator transmitter to the monitoring company of the Owners choice.
 4. Identification of the zone in alarm at the fire alarm control panel.
- 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. Lightning protection shall be a standard feature of the fire alarm control panel.
- P. The control unit shall be flush mounted in a textured finish, 316 gauge steel cabinet equipped with hinged door, and secured by a lock keyed common to the manual stations. Reset switches, silence switches, fuses, etc., shall be clearly marked and shall be behind the locked door to prevent unauthorized entry. Opening of the main door shall expose all components for inspection of adjustment without further dismantling of the cabinet, control unit or wiring.

- Q. 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.
- R. 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 contractor's 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.
- S. Detection and signaling circuits shall be run separate from all other conductors. Wiring shall be number 14 solid.
- T. 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 "tyeraps" and placed in wiring gutters.
- U.. Fire alarm system components shall be as follows (or equal):
1. Fire alarm control panel FACP: NotifierSFP-1028 - 8 zone fire alarm control panel. Panel must be modular, must include alarm verification, one man walk test, auxiliary power supplies as required for the system and integral DACT, two line UL Listed digital communicator which transmits specific zone alarm information. All zones must be transmitted as separate and distinct alarm conditions at the central station. The fire alarm control panel also must be up-loadable and downloadable from the office of the local factory authorized dealer. Contact Norris Inc. (800)-370-FIRE. Batteries: Provide batteries with 60 hours of stand-by followed by 10 minutes of alarm. Provide Notifier BB-17 battery back-box if required. Provide battery calculations as part of submittal.
 2. Ceiling Mounted Smoke Detectors: Notifier 2451 with B-401B 2 wire base.

3. Manual Pull Stations: Notifier BNG-1R - single action - key reset.
4. Horn/Strobe Alarms: Notifier P-24-(XX) series with adjustable volume control. See candela table below - with synchronization modules - Notifier MDL where 2 or more strobes are visible within the same sight line.
5. Strobe Only (per ADA): Notifier ST-24-(XX)-WR See candela table below. Strobes must synchronize with the adjustable volume horn/strobes listed above.
6. Heat Detectors - Fixed Temperature (135°F - 120volts): Notifier HD-603.
7. Annunciation in fire alarm panel shall be as follows:
 - a. Zone 1 – First Floor
 - b. Zone 2 – Second Floor
 - c. Zone 3 – Vault
 - d. Zone 4 – Spare
8. Digital Alarm Communicator included with Panel: Connect the communicator to two(2) active, telephone lines connected prior to any telephones or a telephone system. Communicator shall monitor fire alarm, trouble and supervisory alarms through a private 24 hour central station. The Contractor is responsible for providing a central station contract to the Owner and shall be responsible for all hook-up and programming costs. Annual monitoring costs will be by the Owner.

V. Table of candela ratings is 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.	

2.14 SECURITY SYSTEMS (BY OTHERS)

2.15 MECHANICAL SYSTEM CONNECTIONS

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

2.16 COMPUTER AND TELEPHONE

- A. Furnish boxes, and 3/4" conduit with pull cord to space above ceiling.

- B. Outlets boxes shall be 4x4 steel box mounted on caddy H2-3 bracket with mulberry trim ring #11262.

2.17 TRANSIENT VOLTAGE SURGE SUPPRESSION

- A. The TVSS/Filter shall be constructed using multiple surge current diversion arrays of metal oxide varistors (MOV), matched to 1% variance, each array rated for at least 40KA and 10 surges at 25kA of surge current capacity based on the standard 8 x 20 microsecond waveform. Each array shall be capable of withstanding over 1,250 pulses of the 10kA IEEE 62.41 Category C surge current without failure when tested per C62.11, C62.45, suggested wait times. The array shall consist of multiple gap-less metal oxide varistors, with each MOV individually fused. The arrays shall be designed and constructed in a manner which ensures MOV surge current sharing. No gas tubes, silicon avalanche diodes or selenium plates/rectifiers shall be used. The status of each array shall be continuously monitored and a green LED shall be illuminated if the array is in full working order. All protection mode, including N-G, shall be monitored and internally fused, for compliance to NEC article 110.9, 110.10 and 280.22.

PART 3 - EXECUTION

3.01 LICENSE

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

3.02 COORDINATION

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

3.03 WORKMANSHIP AND PREPARATION

- A. Work shall be executed in 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.

3.04 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.

3.05 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.
- B. Prior to commencement of work, notify and coordinate with the Dig Safe Center - 1-800-225-4977 at least three business days prior to start of any digging operations.

3.06 RACEWAYS

- A. Raceways 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. Provide expansion couplings where underground conduit is connected to fixed structures above grade.
- 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 lodgment 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.

3.07 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. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of wood screw, expansion shields or machine screws if permitted by local authorities.

3.08 FIXTURES

- A. Incandescent and fluorescent fixtures shall be supported by building structural elements independent of furred or suspended ceilings.
- B. Recessed fluorescent fixtures shall be supported by rod or bowchain, minimum of two (2) supports per 4' of fixture.
- C. The minimum number of supports for surface mounted fluorescent or suspended fluorescent fixtures shall equal on for each 4' of length plus one additional support: 4' two (2) supports: 8' three (3) supports: 12' four (4) supports. Additional supports shall be provided if required. Attachment to structural steel shall be bolted type, anchors and inserts shall be installed as an integral part of structural system. Explosive or cartridge driven type insert, anchors or supports are not acceptable.
- D. 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.
- E. Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling T's to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips. Comply with NFPA 70, Article 300.11. If the fire rated ceiling assembly is not rated to support luminaires, do not use the T-Bar grid to support the fixture. Provide an independent support system. Install recessed luminaires to permit removal from below.
- F. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating. Provide Fire Barriers in fire rated suspended ceilings over light fixtures or demonstrate fire rating of fixture housing that matches the ceiling rating as installed per UL 263.
- G. Install clips approved for purpose to secure recessed grid-supported luminaires in place.

3.09 WIRING DEVICES

- A. Switches and convenience outlets shall have a rating as indicated on the drawings. 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. The drawings do not show in detail every conduit, junction box, or fitting, 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 compensation under this section of the specifications. No deviation from the layout shall be made without written approval from the Architect.

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 work as actually installed. Include an accurate layout of in-slab, under-slab, and buried conduits.
- B. Deviations from the Contract Documents shall be favorably reviewed 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 the above changes and representing an accurate record of work as actually installed.
- D. The record drawings shall be submitted to the Architect for review and corrected as deemed necessary.
- E. After favorable review, the record drawings shall become the property of the Owner.

3.12 INSTRUCTIONS, OPERATION AND MAINTENANCE DATA

- A. At the completion of the work, deliver one (1) set of operating and maintenance instructions of equipment and systems to the Owner. 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 all systems contained in Specification Section 16000 to the Owner's representative. The manufacturer's field technician shall be present during the fire alarm 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.

3.13 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 1000 ohms for 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.

* END OF SECTION 16000 *