

- 1 Codes and Standards
 - A. National Electrical Contractors Association (NECA): NECA SI – Standard of Installation.
 - B. National Electrical Manufacturers Association (NEMA): NEMA KS 1 – Enclosed Switches.
 - C. National Electrical Testing Association (NETA):
 1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - D. National Fire Protection Association (NFPA):
 1. NFPA 70 – National Electrical Code.
 2. NFPA 101 – National Life Safety Code.

- 2 Quality Assurance
 - A. Installer Qualifications: Company specializing in performing Electrical Work with minimum 5 years documented experience.

- B. Regulatory Requirements:
 1. Conform to requirements of NFPA 70.
 2. Products: Listed and classified by Underwriters Laboratories, Incorporated as suitable for the purpose specified and indicated.

- 3 Basic Electrical Methods
 - A. Drawings are schematic and diagrammatic. Use judgment and care to install electrical work to function properly and fit within building construction and finishes. Electrical conductors, conduit, components, not shown or specified, which are required for any device or system to produce a complete and operative system are required to be furnished and installed.

- B. Exact location of outlets are determined from dimension on Drawings, manufacturer's shop drawings, or as may be determined at Project Site. Do not scale Drawings for exact location of any item. Verify item mounting heights as required by project conditions prior to rough-in.

- C. Route conduits and wiring associated with new equipment and systems above ceilings, in existing chases, and concealed within building structure.

- D. Surface mounted raceways or conduit permitted only at locations indicated on Drawings.
- E. Branch and home run circuits are indicated as 2, 3, or 4 wire circuits unless otherwise noted. Do not connect two ungrounded conductors to same circuit breaker switch in any panel. Circuit runs consist of a maximum of five conductors; 3 phase conductors, 1 neutral conductor, and ground conductor, unless otherwise noted. Do not splice branch circuit conductors in any panels, safety switches, or non-automatic circuit breakers in separate enclosures.

- G. New equipment, switches, devices, shown mounted on and/or adjacent to equipment, which if installed, would impair proper operation of existing or new equipment, shall be removed and relocated by Contractor as required so equipment will function properly. Notify engineer immediately if any such condition exists.

- H. Seal and make permanently watertight penetrations by electrical raceways or equipment through roofs, ceilings, walls or floors.
 1. Seal penetrations in non-fire rated ceilings, walls or floors.
 2. Seal penetrations in fire rated walls with Firestopping material.

- I. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A, and NFPA 70.

- J. Install equipment and materials to provide required maintenance and code working clearance for servicing and maintenance. Coordinate final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow required space for removal of parts that require replacement or servicing.

- 4 Grounding and Bonding
 - A. Grounding System Resistance: One ohm.

- B. Rod Electrodes:
 1. Material: Copper.
 2. Diameter: 3/4" inch.
 3. Length: 10 feet.

- C. Active Electrodes:
 1. Description: Metallic-salt-filled copper-tube electrode.
 2. Shape: As required to pass test.
 3. Length: As required to pass test.
 4. Connector: U-bolt pressure plate.

- D. Mechanical Connectors: Bronze.
 1. Material: Stranded copper.
 2. Foundation Electrodes: 2/0 AWG.
 3. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

- 5 Hangers and Supports

- A. Product Requirements: Furnish and install approved materials, sizes, and types of anchors, fasteners, and supports to carry loads of equipment and conduit, including weight of wire in conduit plus 300 pounds.

- B. Materials and Finishes: Corrosion resistive.
- C. Anchors and Fasteners:
 1. Steel Structural Elements: Beam clamps and welded fasteners.
 2. Concrete Surfaces: Self-drilling anchors and expansion anchors.
 3. Hollow Masonry, Plaster, and Gypsum Board Partitions: Toggle bolts and hollow wall fasteners.
 4. Solid Masonry Walls: Expansion anchors.
 5. Sheet Metal: Sheet metal screws.
 6. Wood: Wood screws.

- 6 Electrical Identification

- A. Nameplates:
 1. Engraved three-layer laminated phenolic plastic, white letters on black background.
 2. Locations:
 - a. Each electrical distribution.
 - b. Communication cabinets.
 - c. Terminal Cabinets.
 - d. Remote motor starter.
 - e. Separately enclosed circuit breakers.
 - f. Panelboards
 - g. Pull boxes.
 - i. Lighting contactor enclosure.
 - j. Relays.
 - k. Switches and disconnects.
 3. Letter Size:
 - a. Use 1/8 inch letters for identifying individual equipment and loads.
 - b. Use 1/4 inch letters for identifying grouped equipment and loads.

- 7 Starters, Controls, and Connections to Mechanical Equipment

- A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
 1. Allen-Bradley Company.
 2. Eaton Corporation, Cutler-Hammer Products.
 3. Square D company.
 4. General Electric Company, Electrical Distribution and Control Division.

- B. Furnish and Install the Following:
 1. Conduit, wiring and electrical connections to motors, safety switches, starters, relays, electrical interlock circuits, valves, unit heaters, fan coil units, air handling units, and other similar equipment; required for complete and ready for operation. Coordinate with and review other contractors in order to fully understand the wiring requirements.

- 8 Examination
 - A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

- B. Report in writing to engineer prevailing conditions that will adversely affect satisfactory execution of the electrical work. Do not proceed with Work until unsatisfactory conditions have been corrected.

- C. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the owner.

- 9 Grounding and Bonding

- A. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

- B. Provide grounding as required for the power companies transformers and switching equipment

- C. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated.

- D. Provide bonding and grounding in conformance with NFPA 70.

- E. Provide isolated grounding conductor for circuits supplying electronic cash registers, data systems, and communications systems.

- F. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

- G. Testing and Inspection:
 1. Inspect and test in accordance with NETA ATS.
 2. Perform inspections and tests listed in NETA ATS.

- 10 Hangers and Supports

- A. Install products in accordance with manufacturer's published instructions.

- B. Furnish and install anchors, fasteners, and supports in accordance with NECA SI.

- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

- D. Do not use spring steel clips and clamps.

- E. Do not use powder-actuated anchors.

- F. Obtain permission from Structural Engineer before drilling or cutting structural members.

- G. Fabricate supports from structural steel angle or structural steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.

- I. In wet and damp locations use structural steel channel supports to stand cabinets and panelboards one inch off wall.

- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

- 11 Electrical Identification

- A. Install nameplate parallel to equipment lines.

- B. Secure nameplate to equipment front using stainless steel screws. Use minimum two screws at each end of nameplate.

- C. Secure nameplate to outside surface of door on panelboards and switchboards.

- 12 Verify and check equipment manufacturer's nameplate and installation instructions to obtain exact location of outlets for equipment before installation.

13. Load balance all electrical phases, at device, panels, and switchboards.

- 14 Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 1. Verify that interior of building has been protected from weather.
 2. Verify that mechanical Work likely to damage wire and cable has been completed.
 3. Verify that raceway installation is complete and supported.

- 15 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 125 feet.

- 16 Wiring color code 208Y/120 Volt System:
 - Phase A – Black
 - Phase A Switch Leg – Black with 'S' tag.
 - Phase B – Red
 - Phase B Switch Leg – Red with 'S' tag.
 - Phase C – Blue.
 - Phase C – Switch Leg – Blue with 'S' tag.
 - Travelers – Yellow.
 - Neutral – White.
 - Equipment Ground – Green.

17. Raceways

- A. Install conduit in accordance with NECA "Standard of Installation."

- B. Install nonmetallic conduit in accordance with manufacturer's instructions. Nonmetallic conduit shall only be used under slabs or direct buried in earth. Conduit penetrations above slab shall be protected with 3/8" galvanized steel channel to 5' above grade.

- C. Arrange supports to prevent misalignment during wiring installation.

- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- E. Do not support conduit with wire or perforated pipe straps in any type structure. Remove wire used for temporary supports. Steel tie wire may be used to anchor conduit down to reinforcing rods in concrete encasement only.

- F. Do not attach conduit to ceiling support wires.

- G. Arrange conduit to maintain headroom and present neat appearance.

- H. Route all conduit whether exposed or concealed parallel and perpendicular to walls, ceilings, building structures, etc.

- I. Maintain required clearance between conduit and piping.

- J. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

- K. Cut conduit square using saw or pipecutter; de-burr cut ends and ream.

- L. Bring conduit to shoulder of fittings; fasten securely.

- M. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

- N. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. Use myers hub connectors on all conduit entering top or sides of all junction boxes, pull boxes, wiring gutters, exposed to weather.

- O. Install no more than equivalent of three 90-degree bends between boxes. Use conduit benders to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or use factory elbows for bends in metal conduit larger than 2 inch size. Telephone and computer system conduit bends shall not exceed three 90 degree turns prior to installing pull box. Comply with Article 346 of NFPA 70 on all bends.

- P. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

- Q. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

- R. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

- S. Ground and bond conduit per NFPA 70.

- T. Coat all metallic conduit male threads with "General Electric" RTV silicone sealer where conduit is installed in exterior areas or in contact with concrete or earth.

- U. Install all above grade feeders in galvanized or sherardized thick wall rigid steel (GRC), Intermediate metal Conduit (IMC), or Rigid Aluminum (RA).

- V. Cap all upturned conduits during construction rough-in to prevent moisture or debris from entering. Pull through each and every conduit a dry swab of sufficient size to remove any and all moisture.

- W. Maximum 5 foot length flexible metal conduit (Greenfield), or flexible liquidite permitted.

- X. Assure ground continuity on all branch circuitry conduits with two locknuts, one inside and one outside of all boxes, cabinets and gutters for rigid conduit. One locknut inside of all boxes, cabinets, and gutters for EMT.

- Y. Support Conduits as Follows:
 1. Galvanized rigid thick wall conduit (GRC), within three feet of all outlet boxes, junction boxes, cabinets, gutters, or fittings. Horizontally anchored at 10 foot maximum intervals. Other spacings indicated on Drawings.
 2. Intermediate grade rigid conduit (IMC), within three feet of all outlet boxes, junction boxes, cabinets, gutters, or fittings. Horizontally anchored at 10 foot maximum intervals. 3/4 inch minimum size permitted.
 3. Flexible metal conduit, within 12 inches of all outlet boxes, junction boxes, cabinets, gutters, or fittings and bends or turns. Horizontally anchored at 4-1/2 foot intervals. 3/4 inch minimum size permitted.
 4. Liquid-tite flexible conduit, within 12 inches of all outlet boxes, junction boxes, cabinets, gutters, or fittings and bends or turns. Horizontally anchored at 4-1/2 foot intervals. 3/4 inch minimum size permitted.

- 18 BOXES

- A. Install boxes in accordance with NECA "Standard of Installation."

- B. Install in locations as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

- C. Set wall mounted boxes at elevations to accommodate mounting heights indicated or as required for specific project requirements.

- D. Electrical boxes are indicated on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet if required to accommodate intended purpose with no additional cost to contract.

- E. Orient boxes to accommodate wiring devices oriented.

- F. Maintain headroom and present neat mechanical appearance.

- G. Support boxes independently of conduit.

- H. Use approved gang box where more than one device is mounted together. Do not use sectional box.

- I. Use cast outlet box with weatherproof cover in exterior locations exposed to the weather.

- 19 Device installation

- A. Install devices plumb and level.

- B. Install switches with OFF position down. Both up or down for 3 way switches.

- C. Install receptacles with grounding pole on bottom.

- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

- E. Connect wiring devices by wrapping conductor 2/3 of screw diameter in clockwise direction around screw terminal. Tighten screw to 12 pound-inches. Do not use spring pressure devices for wire connections.

- F. Use jumbo size plates, 302 Stainless Steel for outlets installed in masonry walls.

- G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

- H. Install plates on switch, receptacle, and blank outlets.

20. This contractor shall coordinate incoming electrical service with Central Maine Power. Underground vault and transformer will be provided by the power company. Excavation and backfill by general contractor. Secondaries from the transformer to the main switches by this contractor.

21. The electrical service equipment shall be rated for 65 K AIC.

22. This contractor shall install spare conduits for future ground floor tenant loads.

23. All metering shall be coordinated with the power company.

24. House panel shall be a Panelboard with bolt on breakers. Sub-panels can be load centers with series rated for 42 K AIC. Provide test results of integrated short circuit ratings.

25. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers UL 489 listed, with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning and motor equipment branch circuits. Circuit-breakers shall be equipped with individually-insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position "ON" and "OFF". Provisions for additional breakers shall be such that no additional connector will be required to add breakers.

26. Install schedules in all panelboards. Schedules shall designate area and equipment served. Schedules shall be typed.

27. Provide electric heat in the elevator control rooms, the water room, garage storage room and the office and bike shop toilet rooms

28. Provide a complete close circuit video surveillance system (CTV) throughout the garage. Provide cameras on each level of both stair towers, over the automatic garage payment system and at each corner covering each garage level.

29. Furnish and install motion sensor switches on the ceiling where shown on the drawings. Motion sensors shall be dual technology using both infrared and ultrasonic sensing. Sensor shall be Lutron model CDT2000 or equal. Provide power packs to combine sensors and control light fixtures.

30. Furnish and install an electronic control and light sensor with dual outputs for 2 lighting zones. Zone #1 shall be capable of automatically turning on at dusk and off at a user selectable time on any or all days of the week. Zone #1 shall also be capable of turning back on at another user selectable time and then off at dawn. Zone #2 shall automatically turn on at dusk and off at dawn every day. Control shall be capable of 32 on and off set points with minimum settings of 1 minute. Control shall automatically adjust for daylight savings time and leap years. Battery backup shall retain schedules

31. during power outage. Install tork model DGLC or equal (120VAC).

- the work shall include, but not necessarily limited to the following:

- 31.1. UNDERGROUND ELECTRICAL SERVICE
- 31.2. UNDERGROUND TELEPHONE AND CABLE SERVICE CONDUITS
- 31.3. PANELBOARDS AND CIRCUIT BREAKERS
- 31.4. CONDUITS, RACEWAYS, BOXES, FITTINGS, HANGERS AND SLEEVES
- 31.5. FEEDER AND BRANCH CIRCUIT CONDUCTORS
- 31.6. DEVICES AND PLATES
- 31.7. LIGHTING FIXTURES AND LAMPS
- 31.8. EXIT AND EMERGENCY LIGHTING SYSTEM
- 31.9. GENERATOR
- 31.10. CIRCUIT, SYSTEM AND EQUIPMENT GROUNDING
- 31.11. TEMPORARY WIRING
- 31.12. PERMITS, INSPECTIONS, BACK CHARGES AND TESTS
- 31.13. TELEPHONE AND DATA CONDUITS
- 31.14. ELECTRIC HEATERS AND CONTROLS
- 31.15. AUTOMATIC FIRE ALARM SYSTEM
- 31.16. CLOSE TV RECORDING SECURITY SYSTEM
- 31.17. SHOP DRAWINGS
- 31.18. NAME PLATES

32. The following work is to be done by other trades:

- 32.1. EXCAVATION AND BACKFILL
- 32.2. CONCRETE WORK
- 32.3. AUTOMATIC TEMPERATURE CONTROL WIRING
- 32.4. SMOKE DETECTOR CONTROL WIRING FOR SUPPLY AIR FAN SHUTDOWN
- 32.5. ACCESS PANELS
- 32.6. CUTTING AND PATCHING
- 32.7. TELEPHONE AND DATA SYSTEM WIRING

33. Obtain and pay for all required test, permits, inspections, back charges and temporary power construction.

34. All work shown on the plans is intended to be approximately correct to scale, but figured dimensions and detailed drawings are to be followed in every case. The drawings shall be taken in a sense as diagrammatic. Suggested methods of running conduits and cables are shown, but it is not intended to show offsets and fittings, or every structural difficulty that may be encountered.

35. Furnish and install temporary electrical power for building construction. Provide metering, panelboards, lighting, devices and power circuits for tools. Temporary wiring shall be installed per national electric code, article 305 and per BOCA code. Energy cost shall be paid by the general contractor.

36. The electrical contractor shall guarantee his work for a period of one year from the date of final acceptance. If any defects in material or workmanship occur within this period, they shall be corrected at no additional cost to the owner.

37. the electrical contractor shall inspect the site and shall investigate all conditions under which his work will be performed. he shall coordinate his work so that it does not interfere with the work of other trades and the general contractors building schedule.

38. Furnish and install all required circuit and system grounding, enclosure and equipment grounding, bonding to assure electrical continuity and grounding conductors as required. minimum requirements shall be per national electric code, article 250. all exterior conduits shall carry a separate equipment grounding conductor in addition to the conduit ground. size of conductor shall be as noted on the drawings. electronic data system isolated grounding system shall be as noted on the drawings.

39. Conduits underground, in concrete and exposed to weather shall be intermediate metal conduit (imc) or galvanized rigid steel (grs). Dissimilar metals in contact anywhere in the conduit system shall be avoided. Polyvinyl Chloride (PVC) shall be used only where noted on the drawings. PVC shall be schedule 40, and contain a separate ground conductor. Conduits above grade shall be run parallel to building structural walls.

40. Conductors for general wiring shall be copper type THHN/THWN or XHHW, maximum temperature rating for current carrying shall be 75° C. Minimum size conductor shall be #12 AWG for power circuits. Control wiring shall be a minimum of #14 AWG or as noted on the drawings. non-metallic sheathed cable (NM-B) can not be used. metal-clad cable (AC) may be used in areas where approved by the local wire inspector. Aluminum conductors can be used on circuits over 40 amps.

41. Before purchasing the following equipment, submit five (5) complete copies of descriptive equipment shop drawings for review and approval by the architect/engineer through the general contractor.

- 41.1. Panelboards and circuit breakers
- 41.2. Lighting fixtures and lamps
- 41.3. Exit and emergency lighting
- 41.4. Automatic fire alarm system
- 41.5. Electric heating equipment
- 41.6. Generator

42. Furnish and install name plates on all equipment such as switchboards, panelboards, transformers, starters, contactors and disconnect switches. Nomenclature describing equipment shall be inscribed on a phenolic plate and attached with screws.