- Metal clad type MC, armored cable, and fire alarm cable are to use 2-screw malleable iron, zinc plated connectors. Connectors to be provided with insulated throat and be manufactured by Raco, O/Z Gedney or equal.
- k) MI cable terminations and slices are to be as manufactured by the cable manufacturer. All splices are to be 2-hour fire

3) Boxes:

- a) Concealed Interior Outlet boxes: Except as otherwise required by construction, devices or wiring, boxes shall be stamped steel, 4 in. square or octagon for fixtures. Boxes above ceiling shall be 1-1/2 in. deep. Boxes in ceiling or slab shall be 3 in. deep. Boxes in wall for fixtures shall be 2-3/4 in. deep. Boxes in wall for receptacles and switches shall be 1-1/2 in. deep. Furnish with raised covers and fixture studs where required. Without fixture or device: furnish blank cover. Offset back-to-back outlets with minimum 6 in. separation. Devices shall be manufactured by Raco or equal.
- b) Interior exposed or surface mounted outlet and junction boxes shall be of cast metal with Threaded Hubs. Killark. 0/Z Gednev or Crouse Hinds Condulet Type. Covers shall be cast metal.
- c) Exterior surface mounted outlet and junction boxes shall be of cast metal with threaded Hubs, O/Z Gedney, Crouse-Hinds or equal. Covers shall be cast metal and shall be gasketed raintight exterior type.
- d) Junction and pull boxes: Galvanized sheet steel with crew—on covers, except as noted. Furnish with insulated supports for cables. Locations shall be as noted or required and accessible. Provide barriers in new and renovated boxes between 120/208 volt and 277/480 volt wiring. Devices shall be manufactured by Hoffman or equal.
- e) Floor boxes shall be suitable for conduit and devices noted. Raised outlets shall be Hubbell #B2414 Series with above floor fitting. Flush outlets shall be Hubbell #B2414 Series with flush floor fitting. Increase size to suit as necessary. Provide raceways only as herein specified, except as noted. Raceways shall be run concealed, except as noted.
- 4) Provide raceway support utilizing ceiling trapeze, straphangers, or wall brackets. Provide U-bolts at each floor level of riser raceways and connected to acceptable supports. Provide riser clamps at each floor level of riser raceways resting on slab. Spacing of supports shall be a minimum of 10 ft on center for metallic raceway and as required for nonmetallic raceway. Spacing shall be 5 ft on center for wireways and per code and as noted for others. Mount supports to structure masonry with toggle bolts on hollow masonry, expansion shields or inserts in concrete and brick, machine screws on metal, beam clamps on framework, wood screws on wood, and pan through straps in metal deck. Nails, rawl plugs or wood plugs shall not be permitted. Where required by structure, furnish through bolts and fishplates.
- 5) Exposed raceways shall be run parallel with or at right angles to walls. Provide clearance with water, steam or other piping (minimum 3 in, separation from steam and hot water pipes, except 1 in. from pipe cover at crossings and 18 in. for parallel runs). For hung ceiling outlets, run in hung ceiling and connect to ceiling support channels. In masonry and poured concrete, run vertically only.
- 6) Maintain grounding continuity of interrupted metallic raceways with ground conductor, and in flexible conduit for feeders and motor terminal connections.
- 7) Empty raceways over 10 ft long: Provide fish or pull wire, galvanized or nylon rope.
- 8) Raceway and Cable Installation: Rigid steel conduit shall be permitted for feeders and branch circuits. Paint male threads of field—threaded conduit with graphite—base pipe compound and butt conduit ends. Touch up marred surfaces and field-cut threads, CRC-cold galvanized.
 - a) Raceways concealed in the concrete slab rigid steel.
- b) Raceways installed exposed in mechanical and unfinished spaces-rigid steel.
- c) Raceways installed exposed in finished areas surface metal
- d) Flexible taps from junction boxes above hung ceilings to recessed fluorescent lighting fixtures shall be in flexible metal conduit. Provide minimum 4 ft and maximum 6 ft lengths. For final connection to motor terminal box, transformer and other vibrating equipment: provide with polyvinyl sheathing and ground conductor. Minimum length: 18 in. with slack. Connect ground conductor to enclosure or raceway at each end.
- f) Branch circuit wiring installed concealed in ceilings, furred or stud walls — EMT or metal clad cable type MC or healthcare cable type HCF-90.
- g) Feeders in dry locations rigid steel or EMT.
- h) Fire alarm system is to be in a rigid conduit system. Type of conduit system to be as required by locations. Cable installed concealed in ceiling in walls is to be type — MC fire alarm cable or plenum rated fire alarm cable.

field threaded raceways with graphite base pipe compound. Draw

- i) Two-hour rated feeders Mineral Insulated Cable 9) Cut conduit ends square. Ream smooth. Paint male threads of
- 10) Expansion fittings shall be installed at right angles with clip joint centered in expansion joint. Provide a length of run in accordance manufacturer's recommendations. Preset fittings shall allow for temperature variation. For expansion joint crossings, cross at right angles and anchor ends. For raceway not in slab, provide flexible conduit with external bonding jumper strip. In slab, provide O.Z. Type "AX" or Appleton type "XJ" or "XJF" with ground continuity.
- C. For through—the—floor systems, utilize an assembly similar to Hubbell or Wiremold fire rated poke—through—floor box system. For above floor fittings power shall be duplex receptacle or other as noted. Provide separation barrier between power and telephone compartments. Provide junction box on underside of floor. Pack fitting to restore fire rating of floor.

up tight with raceway coupling.

D. Erect wall and switch outlets in advance of furring and fireproofing. Outlet boxes shall be set square and true with building finish. Secure to building structure by adjustable strap iron or grout in with masonry. Verify outlet locations in finished spaces with architectural drawings of interior details and finishes. Provide barriers between switches connected to different phases for voltages exceeding 150 volts to ground.

- Panel, junction and pull boxes shall be located clear of other trades. Conceal junction and pull boxes in finished spaces. Where necessary, reroute raceways or make other arrangements for concealment. Boxes shall be accessible. Provide access doors as required for accessibility. Support boxes from building structure, independent of conduit. Provide floor—to—ceiling channels for mounting on drywall and lightweight construction. Outlet boxes for fixtures recessed in hung ceilings shall be accessible through opening created by removal of fixture. Secure to black iron support. Motor terminal boxes: coordinate with motor branch circuit conduit and wiring; add box volume where required.
- Fire sealants: Provide for raceways and wire passing through floor slots, sleeves or openings in fire-partitions.
- Perform continuity tests of resistance of feeder conduits from service to point of final distribution using 1 conductor return. Maximum resistance shall be 25 ohms.

12. WIRE AND CABLE:

Provide wire and cable complete with accessories. Size

reference shall be AWG except as noted.

- Conductors shall be copper, ASTM standard solid (No. 10 and smaller) or stranded (No. 8 and larger). General use cabling shall be No. 12 minimum. At 120 volts and over 100 ft circuit length, provide No. 10 minimum. At 265 volts and over 200 ft circuit length, provide No. 10 minimum.
- Control and alarm cabling, except as noted, shall be No. 14 minimum. At 120 volts and over 200 ft circuit length, provide No.12 minimum.
- Other voltages and phases: adjust cable sizing as required to maintain code acceptable voltage drop. Increase raceway sizes for larger wire as required.
- Insulation shall be rubber and thermoplastic meeting ASTM and ICEA standards. Type THHN/THWN shall be utilized for feeders and branch circuits except as noted. SFF-2 shall be used for branch circuits located in wiring channels of continuous fluorescent fixtures and in ambient temperatures over 90 Deg. C rated for 600V. Underground service entrance cabling shall be TYPE XHHW/XHHW-2. Provide cross-linked polyethylene insulation (Type XHHW) in exterior locations including underground non-service cables.
- Metal—clad cable (MC) with ground wires shall be utilized as described in "Raceway and Cable Installation". When used in lieu of wiring in conduit, state in proposal that price is based upon the use of MC cable. BX cable shall not be used. Metal clad type MC cable is to have galvanized steel armored jacket with solid copper conductors in sizes #12 AWG through #8 AWG and stranded for sizes #6 AWG through #1 AWG. An insulated internal green ground conductor is to be provided. Interior conductors are to be wrapped with a moisture and fungi resistant paper. MC cable is to be as manufactured by AFC or equal.
- Health care facilities cable or "hospital grade" AC cable is to be type HFC-90 with a galvanized steel armor jacket with a #16 AWG internal bonding wire. Wire/Armor combination plus insulated green ground conductor to provide two grounding means. Conductors are to be solid copper in sizes #12 AWG through #8 AWG and stranded for sizes #6 AWG though #1 AWG. Interior conductors are to be wrapped with a moisture and fungi resistant paper. HFC-90 cable shall be manufactured by ACF or approved equal.
- H. Fire alarm cable is to be type MC cable with a galvanized steel red armored jacket. Conductors are to be solid copper in sizes #18 AWG and #16 AWG with two to eight conductors per cable. Twisted shield pairs are to be sizes #18 AWG and #16 AWG per cable. Insulation is to be type TFN rated for 105 degrees C for a power limited fire protective signaling cable applications. Provide an insulated ground conductor. Cable to be rated for 600V. Fire alarm cable to be as manufactured by AFC or equal.
- I. Mineral insulated cable shall be a factory assembly of one or more copper conductors corresponding to standard AWG sizes. Conductors are to be contained within highly compacted magnesium oxide insulation and enclosed within a seamless, liquid—and—gas tight continuous copper sheath. Cable to be 2 hour fire rated and be as manufactured by Pyrotenax or equal.
- J. Color coding shall be as follows:
 - 1) 120/208 volt system: Black for A phase Red for B phase Blue for C phase
- 2) 277/480 volt system: Brown for A phase Orange for B phase
- Yellow for C phase 3) Neutral wire shall utilize white outer covering throughout. Equipment ground wire shall utilize green
- outer covering throughout. 4) Where color-coded cable is not available, certify in
- writing and request permission to overlap conductors with 6 in. of color taping in accessible locations.
- K. Provide flameproof linen or fiber tags in accessible locations. For feeders indicate feeder number, size, phase and points of origin and terminations. For control and alarm wiring, indicate type (control or alarm), size of wire, and points of origin and terminations. Similar to Stranco Products, Inc.
- L. Terminations, splices and taps under 600 volts: Copper conductors No. 10 and smaller shall utilize compression—type of twist—on spring—loaded connectors and clear nylon—insulated covering. Copper conductors No. 8 and larger shall utilize mechanical bolted pressure or hydraulic compression type using manufacturer's recommended tooling. Cable lugs and connectors shall utilize compression type of same metal as conductor. Provide to match cable, with marking indicating size and type. Copper lug connections to bus bars: use antiseize compound on tang.
- M. Not more than 3 lighting or convenience outlet circuits shall be installed in one conduit unless otherwise indicated. If more than three circuits, derate wire current carrying capacity and maintain code requirements on conduit fill. Neutral conductor shall be counted as a current carrying conductor. Submit to engineer for review prior to installation.
- N. Pull no thermoplastic wires at temperatures lower than 32 dea F. Provide separate raceways for conductors of normal and emergency, 120/208 and 277/480 volt systems, except 480 volt motor branch circuit wiring and related 120 volt control wiring. Thermoplastic wires hall not be installed in computer area raised floors.
- 0. Leave wires with sufficient slack to permit making final connections
- P. Perform continuity and insulation tests. Megger test 100 percent of feeders. 10 percent of branch circuits and motor branch circuits over 25 hp. Perform tests prior to connecting equipment and in presence of authorized representatives. Submit written report of results. Correct or replace cable testing below manufacturer's

13. GROUNDING

- A. An equipment grounding conductor commonly described as a "green wire" shall be provided for all branch circuits protected by overcurrent devices except for lighting branch circuits. Green wire ground shall also be provided for flexible conduit and motor circuits. Metallic raceway continuity shall be maintained with a bare No. 6 wire. Where isolated grounding branch circuits are used, provide a separate and distinctly marked green ground wire. Each Grounding conductor shall serve a maximum of three circuits/poles.
- B. Service and equipment:
 - 1) For separately derived services or service switches, ground the neutral conductor through disconnecting link and ground terminal to water service ground clamp and building steel or driven ground rods in exterior installations.
 - 2) Ground clamps shall be bronze, solderless type with bronze screws, suitable for receiving noted conductors. Mount ground clamp on water service at street side of main service valve. Provide jumper to by-pass water meter.
- C. Run insulated ground conductors in rigid steel conduit or EMT with conductor connected to conduit, through ground fitting at each end.
- D. Ground noncurrent carrying metal parts of distribution panels, switchboards, transformer enclosures, raceways, busway enclosures, controller enclosures, motor frames and other electrical equipment.
- E. Miscellaneous:
 - 1) Ground the following:
 - a) Telephone system. b) Fire alarm system.
 - c) Emergency distribution system.
 - d) Computer equipment.

14. POWER WIRING

A. Provide all power wiring to all motors and equipment furnished under all contracts on the project. Include extensions from controllers to motors and motor connections. Mount and wire all contactors and power devices furnished under all contracts.

15. CONTROL WIRING

- A. Provide all control wiring for motors and equipment furnished under all contracts and as specifically shown on the drawings, except as noted for mechanical/plumbing equipment. Include mounting and wiring of all control devices furnished with
- B. Control wiring less than 120 volts for motors, alarms for equipment furnished under mechanical/plumbing will be provided under mechanical/plumbing specifications.

- A. Provide complete material and accessories as noted by Leviton, Hubbell, or eaual,
- B. Local wall switches shall be specification grade, totally enclosed, toggle, guiet type, rated 20 amp, 120/277 volt, AC. All switches shall be ganged with multi device plates, in areas where dimmers are specified with wall switches; all switches shall match dimmer series and shall be ganged together. Switches shall have screw type terminals and shall be of the white phenolic compound finish, unless otherwise directed by the Architect (coordinate with Architect prior to bid). Toggle switches shall be manufactured as follows:
- 1) 20A, 120/277V Single Pole, Hubbell No. HBL 12211 20A, 120/277V Double Pole, Hubbell No. HBL 1222I 20A, 120/277V Three Way, Hubbell No. HBL 12231 4) 20A, 120/277V Four Way, Hubbell No. HBL 1224 5) DIMMER SWITCHES: LUTRON NOVA T SERIES

LEVITON SIMILAR TO:

1) 20A, 120/277V Single Pole, Leviton #1221-2 2) 20A, 120/277V Double Pole, Leviton #1222-2 3) 20A, 120/277V Three Way, Leviton #1223-2 4) 20A, 120/277V Four Way, Leviton #1224-2

5) DIMMER SWITCHES: LEVITON MURAL SERIES

- Receptacles shall be minimum hospital grade type duplex convenience 125 volts, 2 pole, 3 wire, U ground slot. Grounded, except as noted. Meeting NEMA standards, publication WD-6. Receptacle finish shall be of the white phenolic compound type unless otherwise directed by the Architect (coodinate with Architect prior to bid). Receptacle shall be manufactured as follows:
- HUBBELL HOSPITAL GRADE 1) 20A, 120V Standard Duplex, Hubbell No. HBL 8300 2) 20A, 120V Ground Fault, Hubbell No. GF-8300
- LEVITON HOSPITAL GRADE 1) 20A, 120V Standard Duplex, Leviton #8300
- 2) 20A, 120V Ground Fault, Leviton #8380
- D. Device plates: Coordinate with Architect for type. For receptacles other than 120 volt, inscribed voltage available.
- 1) Brushed 302 stainless steel with engraved circuit identification
- Reinforced thermoplastic by same manufacturer of
- 3) All emergency receptacles shall be hospital grade & red in
- 4) All device plates shall be have an approved label (Dymo or equal) with its panelboard of origin and circuit designation. Label shall be located on device plate and inside receptacle
- E. Colors: Coordinate colors with Architect.
- Mounting orientation of receptacles (horizontal or vertical): Coordinate with Architect.

17. ELECTRICAL TESTING

- A. Provide all necessary meters, instruments, temporary wiring and labor to test and adjust all equipment and wiring installed and/or connected under this contract, including electrical equipment furnished by others, to determine proper polarity, phasing, freedom from grounds and shorts and operation of equipment. All measuring instruments must be properly calibrated
- B. Whenever the authorities having jurisdiction require that any work be tested or approved. Contractor shall provide proper facilities for access for inspection.

C. Check all lighting fixtures and receptacles for proper operation.

D. Motors:

- 1) Make the following tests on the motors before starting up:
- a) Check motor nameplate for horsepower, speed, phase
- 2) Make the following tests on all motors during or immediately after start up:
 - a) Check shaft rotation: Check bearing temperature: Check motor for smooth operation.
 - b) Take a current reading of full load using a clamp on ammeter. If ammeter reading is over the rated full load, current, determine the reason for the discrepancy, and take the necessary corrective
 - c) Following established procedures equipment shall be energized after certifications by the Contractor that the installation's satisfactory. All motors and equipment shall be tested for proper
 - d) Overload elements in motor starters shall be adjusted and checked for suitably to the motor characteristics. Contractor shall replace any overloading element that is inadequate. The cause of any motor operating above full load rating should be investigated and the cause should be removed instead of increasing the overload relay trip rating. These operational tests shall determine that the installation is correct.
- E. After all adjustments are complete, take current readings at full load using a clamp on ammeter and submit to Engineer for
- review and approval. F. Check all system and equipment grounds for proper value of resistance using the Megger ground tester in accordance with manufacturers standard instruction. Test insulation resistance of all new and affected existing feeders prior to energizing.

18. FIRE STOPPING

- A. Drawings and general provisions of contract, including general and supplementary conditions and division specification sections. apply to work of this section.
- B. Provide all required fire-stopping. Work includes fire stopping penetrations of fire-resistance rated floors, walls and partitions in new construction, as well as pre-existing penetrations in renovation areas of existing construction
- C. Product data: Submit manufacturer's product data for each fire—stopping produce required, including instructions

for substrate preparation and fire—stopping installation.

- Fire resistant joint sealers: Provide manufacturer's standard fire-stopping sealant with accessory materials, having fire resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Materials Provide the following:
 - 1) One-part fire-stopping sealant: One part latex based intumescent sealant formulated for use in a through—penetration fire—stop system for sealing openings around cables, conduit, pipes and similar penetrations through walls and floors. Acceptable products/manufacturers include the following:

 - a) Spec Seal LC150 Series b) Hilti FS One

19. DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS

- A. Submit written certification that electrical systems are complete and operational. Submit certification with Contractor's request for final review.
- 1) At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration. The various tests shall be witnessed by the Owner or his Representative.
- B. The Contractor shall furnish all test equipment, materials, labor, and temporary power hook—ups to perform start—up and all tests as required obtaining final field acceptance from Owner. All tests shall be conducted in the presence of the Owner or his Representative. All test procedures shall conform to this specification and applicable standards the ANSI, IEEE, NEMA, OSHA
- The Contractor shall be responsible for all tests and test record. Testing shall be performed by and under the immediate supervision of the Contractor. Test record shall be kept for each piece of equipment. Copies shall be furnished to the Engineer for review and/or approval.
- D. A visual inspection of all electrical equipment, to check for the foreign material, tightness or wiring and connection, proper grounding, matching nameplate charts with specification, etc., shall be made prior to actual testing.
- E. A complete operational test shall be made on the revised life safety fire alarm system. The Contractor shall consult with the equipment vendors and then submit for approval a step-by-step procedure describing the method of making the tests, the equipment to be utilized and the feature to be checked by the test. All interlocks and protective features shall be checked out.

20. SPECIAL ENGINEERING SERVICES

- A. In the instance of complex or specialized electrical systems such as emergency system, fire alarm or similar miscellaneous systems, the installation, final connections and testing of such systems shall be made under the direct supervision of competent authorized service engineer who shall be in the employ of the respective equipment manufacturer.
- Any and all expenses incurred by these equipment manufacturers' representatives related to this project, shall be borne by the Electrical Contractor.

21. DESIGN MODIFICATIONS

A. The drawings show electrical systems that supply, control, and/or monitor systems specified elsewhere. The electrical system shown has been based on specific manufacturers data or information conveyed to the electrical designer. Where any agreement or change is made to supply equipment of larger capacity or different electrical characteristics, the Contractor shall be responsible for providing the electrical system to effect such changes within the intent of these specifications and to inform the Engineer, in writing, of such change. For example, if HVAC compressors and/or motors are allowed to be changed to 230 volts rather than the originally specified 208 volts, boosting or bucking transformers shall be supplied, installed, and wired to accommodate the change at no additional cost.

22. FIRE ALARM SYSTEM

- A. The building is served by a base building addressable fire alarm system. The system will remain and be expanded to accommodate the renovations to the building. During the construction phase the existing system shall be protected from
- damaae. B. Work Included:
 - 1) Work under this section includes the installation of components to form a complete and operative fire alarm system, including removal of the existing addressable
 - fire alarm system devices that are not to be retained. 2) Work shall include, but not limited to, the following:
 - a) Relocation of existing Fire Alarm System components and associated equipment b) Disconnection, removal and disposal of existing fire alarm quipment and wiring c) Testing
 - 3) Furnish and install Fire Alarm System components to work in conjunction with the existing base building addressable fire alarm system as described herein and as shown on the plans; to be wired, connected, and left in first-class operating condition. The system shall include manual station (fire alarm boxes), automatic fire detectors, audio/visual devices, strobes, beacon, door holders, electric door strikes, all wiring, conduit, connections to devices, connections to sprinkler flow and tamper switches, zone modules, SNAC panels, outlet boxes, junction boxes and all other necessary
 - base building system manufacturer. 4) The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials and performance of all operations in connection with the installation of the Fire Alarm System as shown on the

material for a complete operating system. The new fire

alarm system components will be as manufactured by the

5) The complete installation is to conform to the applicable sections of NFPA-72, Local Code Requirements and Maine Electrical Code.

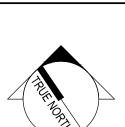
drawings and as herein specified.

- 6) The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.
- 7) The electrical contractor is to coordinate the installation, final connections and testing with the building manager/owners fire alarm system contractor/service company. All costs associated with the building manager/owners contractors as it relates to this project will be paid by this contractor as part of his base bid.

ISSUED FOR CONSTRUCTION DESCRIPTION

99 Bedford Street, 2nd Fl. Boston, MA 02111 T: 617.737.1111 F: 617.737.4311 BAITIMORE / BOSTON / HAMILTON / MEXICO CITY / MINNEAPOLIS NEW HAVEN / NEW YORK / PHILADELPHIA / PUEBLA / SEATTLE ENGINEERING / ANALYSIS & TESTING / BUILDING MANAGEMENT SYSTEMS / CENTRAL UTILITIES CODE CONSULTING / COMMISSIONING / CRITICAL SYSTEMS / ENERGY & SUSTAINABILITY FIRE PROTECTION / IT/AV/SECURITY / LIGHTING DESIGN / SPECIAL INSPECTIONS

ISSUED FOR CONSTRUCTION 2-27-17



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ARCHITECTURE ENGINEERING PLANNING INTERIORS E MAINE MEDICAL CENTER BRAMHALL CAMPUS

MRI #1 REPLACEMENT PORTLAND, MAINE **ELECTRICAL SPECIFICATIONS**

SHEET TITLE: PROJECT MANAGER: PROJECT NO: B160143-004 A/E OF RECORD:

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