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ELECTRICAL SPECIFICATIONS

PART 1 - GENERAL REQUIREMENTS

A. GENERAL REQUIREMENTS:

1. IN GENERAL, THE ELECTRICAL WORK SHALL CONSIST OF THE FOLLOWING:
 - A. THE CONTRACTOR SHALL BE RESPONSIBLE TO DISCONNECT AND REMOVE ALL BRANCH CIRCUIT WIRING TO EXISTING EQUIPMENT, ALL EXISTING CONDUIT, WIRING, WIRING DEVICES, PANELBOARDS AND LIGHTING FIXTURES SHALL BE REMOVED WITHIN THE AREA OF WORK.
 - B. REMOVE AND INSTALL NEW SERVICE, PANELBOARDS, FEEDERS, BRANCH CIRCUITS, WIRING DEVICES, AND CONDUITS AS REQUIRED AND AS SHOWN ON THE DRAWINGS.
 - C. INSTALL NEW EQUIPMENT AND PROVIDE A COMPLETELY AND FULLY OPERATIONAL SYSTEM AS HEREIN STATED, INCLUDE ANY AND ALL EQUIPMENT, APPARATUS, ETC. THAT REQUIRES TEMPORARY RELOCATION TO PERFORM THE WORK AS INTENDED, EXCEPT FOR THE TIME LISTED IN SECTION RELATED WORK BY OTHERS.
 - D. CONTRACTOR SHALL REMOVE ANY UNUSED CONDUIT.
 - E. THE OWNERS GENERAL CONDITIONS, SPECIAL CONDITIONS AND SUPPLEMENTAL CONDITIONS OR REQUIREMENTS ARE PART OF THIS WORK.
 - F. THE INSTALLATION OF THE SYSTEMS SHALL CONFORM TO THE REQUIREMENTS OF THE MASSACHUSETTS ELECTRIC CODE, NATIONAL FIRE PROTECTION ASSOCIATION AND ALL OTHER APPLICABLE FEDERAL, STATE AND LOCAL LAWS AND ORDINANCES.
 - G. ALL MATERIALS SHALL BE NEW AND SHALL BEAR THE UNDERWRITER'S LABEL.
 - H. OBTAIN AND PAY FOR ALL REQUIRED PERMITS, LICENSES AND CERTIFICATES, INCLUDE ALL FEDERAL, STATE AND LOCAL TAXES.
 - I. ERECT EQUIPMENT AND MATERIALS IN NEAT AND WORKMANLIKE MANNER. ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
 - J. THE ELECTRICAL CONTRACTOR (EC) SHALL VERIFY THE LOCATIONS AND MOUNTING HEIGHTS OF ALL EQUIPMENT, LIGHT FIXTURES, PANELBOARDS, OUTLETS AND MECHANICAL EQUIPMENT WITH THE OWNER PRIOR TO COMMENCING ANY WORK.
 - K. THE EC SHALL NOT BORE, NOTCH OR IN ANY WAY CUT INTO THE STRUCTURAL MEMBER, WITHOUT PROPER WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER.
 - L. EXAMINE ALL DRAWINGS AND OTHER SPECIFICATIONS OF THE SPECIFICATIONS FOR REQUIREMENTS WHICH AFFECT THE WORK OF THIS SECTION. COORDINATE WORK WITH OTHER TRADES.
 - M. PROVIDE TEMPORARY POWER AND LIGHTING DURING CONSTRUCTION. POWER CONSUMPTION CHARGES SHALL BE PAID BY OWNER.
 - N. THE COMPLETED ELECTRICAL INSTALLATION SHALL BE GUARANTEED IN WRITING BY THE ELECTRICAL CONTRACTOR TO BE FREE FROM DEFECTS OF MANUFACTURE AND INSTALLATION FOR A PERIOD OF ONE YEAR FROM THE DATE OF WRITTEN ACCEPTANCE BY THE OWNER. ANY DEFECTS FOUND SHALL BE CORRECTED BY THE ELECTRICAL CONTRACTOR WITHOUT EXPENSE TO THE OWNER.
 - O. THE EC SHALL NOTIFY THE OWNER UPON: (1) COMPLETION OF ALL ROUGH WIRING BEFORE COMMENCEMENT OF ALL FINISH WIRING, (2) COMPLETION OF ALL ELECTRICAL WORK, AFTER SUBSTANTIAL COMPLETION, THE OWNER'S REPRESENTATIVE SHALL PREPARE A PUNCH LIST (THIS TO BE CORRECTED, THE EC SHALL CORRECT, AT NO ADDITIONAL COST, ANY DEFICIENCIES FOUND).
 - P. THE GENERAL CONTRACTOR SHALL PROVIDE PLASTER CUTTING AND CHANNELLING AND DRILLING THROUGH STRUCTURAL BEAMS NECESSARY FOR MANUFACTURE AND INSTALLATION FOR A CONTRACTOR SHALL PROVIDE ROUTING DRILLING THROUGH 24 AND/OR 2X8 WOOD FRAME WALLS AND 2X10 AND/OR 2X12 WOOD JOISTS TO ENABLE THE INSTALLATION OF ELECTRICAL WIRING.

B. RELATED WORK BY OTHERS

1. THERMOSTATS AND CONTROL WIRING SHALL BE SUPPLIED AND INSTALLED BY THE HVAC CONTRACTOR.
2. STARTERS FOR MECHANICAL EQUIPMENT SHALL BE SUPPLIED BY THE MECHANICAL CONTRACTOR, INSTALLED AND WIRED IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS.
3. CUTTING, PATCHING AND TRENCHING SHALL BE PROVIDED BY THE GENERAL CONTRACTOR.

C. SUBMITTALS

1. SUBMITTALS (EC) SHALL PROVIDE FOUR (4) COPIES OF SUBMITTALS FOR ELECTRICAL EQUIPMENT TO THE ENGINEER FOR APPROVAL, PRIOR TO CONSTRUCTION. SUBMITTALS SHALL INDICATE ALL MATERIALS AND RATING INFORMATION ON THE FOLLOWING ITEMS:
 - A. LIGHT SWITCHES AND RECEPTACLES
 - B. PANELBOARDS
 - C. ALL FIRE DETECTION SYSTEM COMPONENTS
 - D. FUSIBLE SWITCHES
 - E. WIRING DEVICES
 - F. CONDUIT
 - G. WIRE
 - H. TEST REPORTS

D. SUBSTITUTIONS

1. MATERIALS, EQUIPMENT, APPARATUS OR OTHER PRODUCTS ARE SPECIFIED BY MANUFACTURER, BRAND NAME, TYPE OR CATALOG NUMBER TO ESTABLISH THE DESIRED QUALITY OF THE WORK AND SHALL NOT BE SUBSTITUTED WITHOUT PRIOR APPROVAL FROM THE OWNER (PROJECT ENGINEER).
2. THE PROCEDURE FOR SUBSTITUTION SHALL BE VIA SUBMITTING TO THE PROJECT ENGINEER SPECIFICATION SHEETS AND DRAWINGS CLEARLY SHOWING THE MATERIAL, EQUIPMENT AND WIRING CHANGES.
3. WHERE SUBSTITUTIONS ALTER THE DESIGN OR SPACE REQUIREMENTS THE CONTRACTOR SHALL ACCOMPLISH THE REVISED DESIGN AND CONSTRUCTION WITH NO ADDITIONAL CHARGES TO THE OWNER.
4. THE GENERAL ARRANGEMENT AND SIZES OF THE CONDUIT, WIRE AND MATERIAL INDICATED ON THE DRAWINGS ARE BASED ON EQUIPMENT FOR WHICH MANUFACTURER NAMES ARE GIVEN IN THE SPECIFICATION OR INDICATED ON THE DRAWINGS. SHOULD THE CONTRACTOR (ELECTRICAL, HVAC, OR PLUMBING CONTRACTOR) SUBMIT A REQUEST FOR SUBSTITUTION OF EQUIPMENT, THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALTERING THE SPECIFICATION AND SIZES OF THE ASSOCIATED CONDUIT, WIRE AND MATERIAL TO ACCOMMODATE THE EQUIPMENT AT NO ADDITIONAL COST TO THE OWNER. DETAILED DRAWINGS SHOWING EACH REQUIRED CHANGE SHALL BE SUBMITTED FOR APPROVAL OF THE ENGINEER AND NO SUCH CHANGE SHALL BE MADE WITHOUT WRITTEN APPROVAL.

E. CONTRACT DRAWINGS:

1. ELECTRICAL DRAWINGS ARE GENERALLY DIAGNOSTIC AND SHOW THE ARRANGEMENT AND LOCATION OF ELECTRICAL EQUIPMENT, DEVICES AND MATERIALS. THE CONTRACTOR SHALL CAREFULLY INVESTIGATE THE STRUCTURAL AND FINISH CONDITIONS AFFECTING HIS/HER WORK AND ARRANGE IT ACCORDINGLY. SHOULD CONDITIONS ON THE JOB MAKE NECESSARY TO REARRANGE CONDUIT OR EQUIPMENT THE CONTRACTOR SHALL SO ADVISE THE OWNER (PROJECT ENGINEER) AND SECURE HIS APPROVAL BEFORE PROCEEDING WITH SUCH WORK.
2. THE RIGHT IS RESERVED BY THE ENGINEER TO MAKE MINOR CHANGES TO ACCOMMODATE ANY CONDITIONS WHICH MAY ARISE DURING THE WORK WITHOUT ADDITIONAL COMPENSATION TO THE CONTRACTOR FOR SUCH CHANGES.
3. DURING THE PROGRESS OF WORK, THE CONTRACTOR SHALL RECORD, ON A SET OF DRAWINGS MAINTAINED FOR THIS PURPOSE, ALL REVISIONS IN ANY PORTION OF THE ELECTRICAL WORK, AS AUTHORIZED BY THE CONTRACTOR'S OWNERS. THE CONTRACTOR SHALL PROVIDE THE OWNER FOUR (4) SETS OF CORRECTED DRAWINGS, CLEARLY MARK TO SHOW ANY CHANGES IN THE ACTUAL INSTALLATION FROM THAT SHOWN ON THE CONTRACT DRAWINGS OR THE CONTRACTOR'S SHOP DRAWINGS. CHANGES TO SHOP DRAWINGS SHALL BE MADE ON THE ORIGINAL TRACINGS AND RESUBMIT FOR APPROVAL.
4. THE CONTRACTOR SHALL VISIT THE SITE AND BECOME ACQUAINTED WITH THE CONDITIONS PRIOR TO PERFORMING THE WORK.
5. ALL WORK SHALL BE DONE IN A NEAT AND WORKMANLIKE MANNER.
6. ALL EQUIPMENT, DEVICES, MATERIAL, ETC., SHALL BE NEW AND UNUSED AND WHEN OF A GIVEN KIND OR TYPE SHALL BE OF THE SAME MANUFACTURE.
7. THE ELECTRICAL CONTRACTOR SHALL COORDINATE THE LOCATIONS OF ALL ITEMS INSTALLED UNDER THIS SECTION WITH ITEMS INSTALLED BY OTHER TRADES TO THE EXTENT THAT INTERFERENCE BETWEEN SUCH ITEMS ARE AVOIDED WITHOUT ADDITIONAL COST TO THE OWNER.

PART 2 - PRODUCTS

A. HANGERS AND SUPPORTS:

1. FURNISH AND INSTALL ALL HANGERS AND SUPPORTS AS REQUIRED BY APPLICABLE CODES AND STANDARDS AND AS MAY BE SHOWN ON THE DRAWINGS.
2. THE USE OF ANCHORS SET BY HAND DRIVEN IMPACT DEVICES IS NOT PERMITTED IN BLOCK OR TILE CONSTRUCTION. SUCH ANCHORS MAY BE SET IN CONCRETE OR BRICK WHERE THE THICKNESS OF THE WALL OR SLAB IS AT LEAST ONE AND ONE HALF (1 1/2) TIMES THE LENGTH OF THE ANCHOR BODY.
3. HANGER ROD SHALL BE STEEL. THE CONTRACTOR SHALL SIZE HANGER IN ACCORDANCE WITH MANUFACTURERS DATA. ALL HANGER RODS SHALL BE FREE OF BURRS WITH THE THREADS ACCURATELY CUT. RODS SHALL BE PROPERLY ALIGNED SO THAT THEY HAVE PLUMB WITHOUT BENDS OR OFFSETS.
4. ALL HANGERS AND SUPPORTS SHALL BE INSTALLED IN ACCORDANCE WITH APPLICABLE CODE REQUIREMENTS TO PROVIDE ADEQUATE SUPPORT FOR ALL ELECTRICAL EQUIPMENT, CONDUIT, AND/OR RACEWAYS.

B. CONDUIT, TUBING, BOXES, AND FITTINGS:

1. WHERE THE WORD CONDUIT APPEARS WITHIN THIS SPECIFICATION IT SHALL INDICATE ELECTRICAL RACEWAYS IN GENERAL. SPECIFIC RACEWAYS ARE CALLED OUT BY THE PROPER AND/OR TRADE NAME SUCH AS RIGID STEEL, INTERMEDIATE METAL CONDUIT, ELECTRICAL METALLIC TUBING (EMT/THINWALL CONDUIT), ETC.
2. FURNISH AND INSTALL CONDUIT OF THE TRADE SIZES INDICATED ON THE DRAWINGS AND AS SPECIFIED. LOCATION AND TYPE OF CONDUIT SHALL BE AS LISTED BELOW UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
3. PVC ELECTRICAL CONDUIT SHALL NOT BE INSTALLED INDOORS.
4. ALUMINUM CONDUIT SHALL NOT BE INSTALLED.

5. SURFACE MOUNTED CONDUIT RUNS INSTALLED INSIDE BUILDINGS, NOT SUBJECT TO PHYSICAL DAMAGE, SHALL BE TYPE EMT CONDUIT (ELECTRICAL METAL TUBING).
6. ELECTRICAL METALLIC TUBING ELBOWS AND BENDS SHALL BE MADE OF THE SAME GRADE OF MATERIAL AND GALVANIZED, SHERADIZED OR OTHERWISE PROCESSED IN THE SAME MANNER AS THE STRAIGHT LENGTHS. COUPLERS AND CONNECTORS SHALL BE SET SCREW TYPE, WET LOCATIONS SHALL BE RAIN-TIGHT COMPRESSION TYPE.

7. ELECTRICAL METALLIC TUBING (EMT) SHALL HAVE A UNIFORM WALL THICKNESS SUFFICIENTLY ACCURATE TO PERMIT THE APPLICATION OF APPROVED COUPLERS AND FITTINGS. THE EXTERIOR SURFACE SHALL BE THOROUGHLY AND EVENLY COATED (GALVANIZED OR SHERADIZED) WITH METALLIC ZINC APPLIED DIRECTLY TO THE SURFACE OF THE STEEL, SO THAT METAL-TO-METAL CONTACT AND GALVANIC PROTECTION AGAINST CORROSION ARE PROVIDED. THE EXTERIOR SURFACE SHALL BE PROTECTED BY COATING BY ZINC EXAMAL, OR OTHER SUITABLE CORROSION RESISTANT COATING.
8. CONDUIT RUNS CONCEALED IN DROP CEILING OR WITHIN WALL CAVITIES, NOT SUBJECT TO PHYSICAL DAMAGE, SHALL BE TYPE MC CABLE.

9. POLYVINYL CHLORIDE (PVC) CONDUIT, SHALL BE USED FOR BELOW GRADE AND/OR DENSE APPLICATIONS.
10. PVC CONDUIT SHALL BE SCHEDULE 40 RATED FOR 90 DEGREE C, UL RATED AND SHALL COMPLY WITH ASTM SPECIFICATION TC-3 (CONDUIT), TC-3 (FITTINGS) AND UL-961 STANDARD FOR RIGID NONMETALLIC CONDUIT. CONDUIT FITTINGS SHALL BE HOMOGENEOUS PLASTIC MATERIAL FREE FROM Voids, CRACKS, HOLES OR FOREIGN INCLUSIONS. CONDUIT SHALL BE MANUFACTURED BY CARBON CAL PIPE, WALZYL, OR APPROVED EQUAL.

11. EXPOSED CONDUIT RUNS ABOVE GROUND INSIDE BUILDINGS WHERE SUBJECT TO PHYSICAL DAMAGE SHALL BE TYPE EMT (GALVANIZED RIGID CONDUIT).
12. RIGID STEEL METAL CONDUIT SHALL HAVE A UNIFORM WALL THICKNESS SUFFICIENTLY ACCURATE TO PERMIT THE CUTTING OF CLEAN, TRUE THREADS. THE EXTERIOR SURFACE SHALL BE THOROUGHLY AND EVENLY COATED (GALVANIZED OR SHERADIZED) WITH METALLIC ZINC APPLIED DIRECTLY TO THE SURFACE OF THE STEEL, SO THAT METAL-TO-METAL CONTACT AND GALVANIC PROTECTION AGAINST CORROSION ARE PROVIDED. THE INTERIOR SURFACE SHALL BE PROTECTED BY ZINC EXAMAL, OR OTHER EQUIVALENT CORROSION-RESISTANT COATING. THE CONDUIT SHALL BE THREADED AT EACH END, A COUPLING SHALL BE SUPPLIED FOR ONE END AND A MEANS OF PROTECTION FOR THE THREAD AT THE OTHER END. ALL THREADS SHALL BE CLEANLY CUT AND PROPERLY COATED TO PROTECT AGAINST CORROSION.

13. RIGID CONDUIT ELBOWS, BENDS, COUPLERS AND NIPPLES FOR RIGID METALLIC CONDUIT SHALL BE MADE OF THE SAME GRADE OF MATERIAL AND GALVANIZED, SHERADIZED OR OTHERWISE PROCESSED IN THE SAME MANNER AS THE STRAIGHT LENGTHS. FITTINGS SHALL BE OF THE SAME MANUFACTURER AS THE STRAIGHT LENGTHS.
14. EQUIPMENT CONNECTION TO MOTORS, CONTROL DEVICES, ETC., SUBJECT TO VIBRATION OR REQUIRING PERIODIC REMOVAL, SHALL BE FLEXIBLE STEEL CONDUIT, LENGTHS OF FLEXIBLE CONDUIT OF ANY TYPE GREATER THAN 6" SHALL NOT BE ACCEPTABLE IN NET OR CORROSIVE AREAS OR OTHERWISE DESIGNATED FLEXIBLE CONDUIT SHALL BE LIQUID-TIGHT FLEXIBLE STEEL CONDUIT.

15. LIQUID-TIGHT FLEXIBLE STEEL CONDUIT CONNECTORS SHALL HAVE A TAPERED THREAD FOR LIQUID TIGHT SEAL AND SHALL MAINTAIN POSITIVE RELIABLE GROUND CONNECTIONS WITH THE CONDUIT.
16. AN INSULATED GROUND WIRE SHALL BE RUN IN ALL RACEWAYS.

17. EXPANSION FITTINGS SHALL BE INSTALLED ACROSS EXPANSION JOINTS.
18. PULL SLEEVE AND EXPANSION FITTINGS SHALL BE MADE OF THE SAME MATERIAL AS THE CONDUIT TO WHICH IT IS ATTACHED. EXPANSION FITTINGS SHALL BE SUPPLIED WITH COOPER BONDING JUMPERS.

C. TYPE MC CABLE

1. ALL FLEXIBLE METALLIC CABLE SHALL BE TYPE MC
2. TYPE MC CABLE SHALL BE PERMITTED TO BE INSTALLED CONCEALED ABOVE SUSPENDED CEILINGS AND WITHIN MASONRY WALL CAVITIES.
3. MC CABLE SHALL NOT BE INSTALLED SURFACE MOUNTED, EXPOSED ON DRYWALL, PLYWOOD OR CONCRETE SURFACES.
4. TYPE MC CABLE SHALL NOT BE EMBEDDED WITHIN CONCRETE OR PLASTER.
5. TYPE MC CABLE SHALL BE USED FOR 20A AND 30A RATED BRANCH CIRCUIT WIRING ONLY.
6. TYPE MC CABLE SHALL BE HOSPITAL GRADE, 12/2 WITH FULL SIZE INSULATED GROUND WIRE.
7. TYPE MC CABLE SHALL BE FLEXIBLE STEEL CONDUIT OF THE SINGLE-STRIP TYPE, GALVANIZED OR SHERADIZED, AND SHAPED INTO INTERLOCKING CONVOLUTIONS OF UNIFORM CROSS SECTION, PROVIDING A SMOOTH INTERIOR AND EXTERIOR SURFACE. THE CONVOLUTION SHALL BE FIRMLY JOINED TO ONE ANOTHER TO ASSURE A COMPLETE LOCK WITHOUT IMPEDING THE FLEXIBILITY OF THE CONDUIT. SHALL BE DESIGNED TO PERMIT THE APPLICATION OF APPROVED FITTINGS.

D. TYPE NM CABLE

1. TYPE NM CABLE, ROMEX, SHALL NOT BE USED.
2. WIRE:
 - A. FURNISH, INSTALL AND CONNECT ALL WIRE IN ACCORDANCE WITH THE REQUIREMENTS OF THE DRAWINGS AND SPECIFICATIONS.
 - B. ALL FEEDERS AND BRANCH CIRCUIT RUNS SHALL INCLUDE A MINIMUM SIZE NO. 12 AWG GREEN, INSULATED GROUND CONDUCTOR UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS.
 - C. ALL WIRE SHALL BE DELIVERED TO THE JOB SITE ON REELS AND/OR IN COMPLETE COILS, PROPERLY PACKAGED AND IDENTIFIED.
 - D. ALUMINUM CONDUCTORS SHALL NOT BE INSTALLED.
 - E. CONDUCTORS LARGER THAN NO. 10 AWG SHALL BE STRANDED.
 - F. ALL WIRE USED FOR FEEDERS, AND SUB FEEDERS SHALL HAVE THE OUTER COVERING OF THE CONDUCTOR MARKED WITH COLOR CODING TAPE AS FOLLOWS: FOR 120/120 VOLT SYSTEMS WITH BLACK FOR "A", RED FOR "B", AND BLUE FOR "C" PHASES, WHITE FOR NEUTRAL AND GREEN FOR INSULATED GROUND; FOR 480/277 VOLT SYSTEMS WITH BROWN FOR "A", ORANGE FOR "B", YELLOW FOR "C", PHASE, WHITE WITH BROWN STRIP FOR NEUTRAL AND GREEN FOR INSULATED GROUND. CONDUCTORS SHALL BE MARKED AT BOTH ENDS AND IN ALL JUNCTION BOXES BY APPROVED PLASTIC TAPE APPLIED SPRAILY AND HALF LAPPED OVER THE EXPOSED PORTIONS OF THE CONDUCTOR INSULATION.
 - G. ALL CONDUCTORS SHALL BE COPPER.
 - H. MINIMUM SIZE CONDUCTORS SHALL BE NO. 12 AWG EXCEPT FOR CONTROL USE.
 - I. UNLESS OTHERWISE SPECIFIED OR INDICATED ON THE DRAWINGS, THE TYPE OF CONDUCTOR INSULATION SHALL BE TYPE THHN, THWN, THWN-2 OR XHHW.

F. RECEPTACLES

1. EXCEPT WHERE INDICATED OTHERWISE OR REQUIRED BY CODE, CONVENIENCE RECEPTACLES SHALL BE COMMERCIAL GRADE GROUNDING TYPE, RATED 30 AMPS, 125 VOLTS. RECEPTACLES SHALL BE BACK AND SIDE WIRED WITH SCREW TYPE TERMINALS OR PRESSURE TYPE, SCREWLESS TERMINALS HAVING SUITABLE CONDUCTOR RELEASE ARRANGEMENT. ALL RECEPTACLES SHALL BE WHITE. RECEPTACLES SHALL BE PASS AND SEMI-OUR MODEL, P55322W OR APPROVED EQUAL.

2. PROVIDE COMMERCIAL GRADE (1) DUPLEX RECEPTACLES AS REQUIRED BY CODE. RECEPTACLES SHALL EACH HAVE (2) TRIPPING (NO FEED THROUGH IS PERMITTED). RECEPTACLES SHALL BE RATED 20 AMP, 125 VOLT. ALL GFI RECEPTACLES SHALL BE WHITE. RECEPTACLES SHALL BE PASS AND SEMI-OUR MODEL, P55322W OR APPROVED EQUAL.
3. FLOOR RECEPTACLES: PROVIDE WIREMOLD SERIES 800 FLOOR BOXES. FLOOR BOX SHALL BE APPROVED FOR USE IN (CONCRETE, WOOD) FLOOR. FLOOR BOX SHALL BE (ONE, TWO, THREE) GANG AND SHALL BE (STAMPED STEEL CAST IRON) CONSTRUCTION. USE CAST IRON FOR BOXES INSTALLED "IN GRADE" IN CONCRETE SUBJECT TO MOISTURE).

- a. BOXES SHALL BE EQUIPPED WITH REMOVABLE BARRIER BETWEEN COMPARTMENTS.
- b. SINGLE GANG STEEL SQUARE FLOOR BOX SHALL HAVE FIVE (5) 1/2" AND FIVE (5) 3/4" THREADED CONDUIT OPENINGS. TWO GANG STEEL FLOOR BOX SHALL HAVE EIGHT (8) 1/2" AND EIGHT (8) 3/4" THREADED CONDUIT OPENINGS. THREE GANG STEEL FLOOR BOX SHALL HAVE ELEVEN (11) 1/2" AND ELEVEN (11) 3/4" THREADED CONDUIT OPENINGS.

- c. FLOOR BOX SHALL HAVE (BRASS, BRUSHED ALUMINUM, NON-METALLIC) COVERPLATES AND FLANGES.
- d. BRASS, 8868, 8076, 8860, PROVIDE RECTANGULAR COVERPLATE MODEL xxx.

- e. WATERPROOF-IN-USE COVERPLATE, PROVIDE LOW PROFILE, IN-USE BACKBOX AND COVERPLATE MANUFACTURED BY ARLINGTON INDUSTRIES. ORIENTATION AND TYPE OF COVERPLATE SHALL BE (VERTICAL/CLEAR, VERTICAL/WHITE, HORIZONTAL/CLEAR, HORIZONTAL/WHITE). BACKBOX AND COVERPLATE SHALL BE USED ON (NEW CONSTRUCTION, RETROFIT APPLICATION) FOR (WALL, CEILING, STUCCO, TEXTURED SURFACES, ROOF SADDING, FLAT SURFACE) CONSTRUCTION.

g. LIGHTING FIXTURES & CONTROLS:

1. LIGHTING FIXTURES, FIXTURES SHALL BE PROVIDED COMPLETE, WITH LAMPS, AS SHOWN ON THE FIXTURE SCHEDULE. FURNISH ALL FITTINGS AND OTHER MISCELLANEOUS MATERIALS FOR COMPLETE INSTALLATION OF FIXTURES.
2. TOGGLE SWITCHES: PROVIDE TOGGLE SWITCHES AS SHOWN ON THE DRAWINGS. TOGGLE SWITCHES SHALL BE COMMERCIAL GRADE, WHITE, WITH STAINLESS STEEL FACEPLATES. TOGGLE SWITCHES SHALL BE INSTALLED UNLESS NOTED OTHERWISE. PROVIDE PROTECTION AGAINST CORROSION.

3. DIMMER SWITCHES: FOR NONDIMENSIONED LOADS, PROVIDE SLIDE BAR, 120 VOLT DIMMER SWITCHES SIMILAR OR EQUAL TO LIGHTVULVE DIMMER SERIES DIMMERS SHALL HAVE PRESET SLIDE BAR WITH AN OFF STATUS LED. DIMMERS SHALL BE RATED 800 WATT (MODEL NO. 2P400) OR 1000 WATT (MODEL NO. 2P1000) AS INDICATED ON THE DRAWINGS. FOR LOADS GREATER THAN 1000W, PROVIDE LIGHTVULVE MOMENTUM SERIES DIMMERS SHALL BE RATED 1500 WATTS (MODEL NO. MP1500) OR 2000 WATTS (MODEL NO. MP2000) AS INDICATED ON THE DRAWINGS.

4. OCCUPANCY SENSORS: OCCUPANCY SENSORS SHALL BE CEILING MOUNTED FOR AUTOMATIC CONTROL OF LIGHTING FIXTURES. SENSORS SHALL OPERATE AT 24VDC/VA/VA AND SHALL BE POWERED FROM A WATT STOPPER POWER PAK. SENSORS SHALL HAVE A 1" DELAY WHICH IS ADJUSTED AUTOMATICALLY OR SHALL BE A FIXED TIME ADJUSTABLE FROM 5 TO 10 MINUTES. SET BY A DIP SWITCH. WATT STOPPER POWER PAK SHALL BE MODEL B60. PROVIDE WATT STOPPER OCCUPANCY SENSORS, MODELS W500A, W1000A AND D1-305 AS SHOWN ON THE DRAWINGS.

H. CIRCUIT BREAKERS

1. ALL MULTI-POLE CIRCUIT BREAKERS INSTALLED IN EXISTING PANELS SHALL HAVE A COMMON INTERNAL TRIP MECHANISM TO OPERATE ALL POLE SIMULTANEOUSLY. HANDLE SHALL NOT BE PERMITTED. ALL NEW CIRCUIT BREAKERS SHALL HAVE DETACHED PANEL AC BATING. CIRCUIT BREAKERS SHALL BE MANUFACTURED BY THE SAME COMPANY WHICH MANUFACTURED THE PANELBOARD.

2. PANELBOARDS:
 - A. PROVIDE DEAD FRONT PANELBOARDS, SURFACE OR FLUSH MOUNTED AS REQUIRED. PANELBOARDS SHALL BE MOUNTED WITH CABINET TOP AT 7'8" ABOVE FINISHED FLOOR. PANELBOARDS SHALL BE RATED FOR SINGLE PHASE 120/240 VOLT SERVICE AND SHALL HAVE COPPER BUS. PROVIDE FULL SIZE INSULATED NEUTRAL BUS AND GROUND BUS. ALL BREAKERS SHALL BE BOLT-ON TYPE. ALL PANELBOARDS SHALL HAVE SEPARATE, VERTICALLY MOUNTED MAIN CIRCUIT BREAKER (UNLESS OTHERWISE NOTED). PANELBOARDS SHALL HAVE DOOR-IN-DOOR CONSTRUCTION. PANELBOARDS SHALL BE FULLY RATED FOR AG RATING AS SHOWN ON THE DRAWINGS. LOW CENTER TYPE PANELBOARDS ARE NOT ACCEPTABLE. SERIES RATED PANELBOARDS INCLUDE AN EXCLUSIVELY DESIGNATED SPACE EXTENDING FROM THE FLOOR TO THE STRUCTURAL CEILING WITH A WIDTH THAT OF THE EQUIPMENT (30 INCHES MINIMUM) AND A DEPTH OF 36 INCHES. NO PILING, OUTCROCK OR EQUIPMENT FOREIGN TO THE ELECTRICAL EQUIPMENT SHALL BE PERMITTED TO BE INSTALLED IN, ENTER OR PASS THROUGH SUCH SPACE. ALL PANELBOARDS SHALL BE MOUNTED SO THAT THE DISTANCE FROM THE TOP CIRCUIT BREAKER OPERATING HANDLE TO THE FLOOR SHALL NOT EXCEED 6'-6". PROVIDE CIRCUIT BREAKER HANDLE LOCK-ON ACCESSORY FOR A CONSTANTLY POWERED CIRCUIT SUCH AS EOT LIGHTING, EMERGENCY LIGHTING AND NIGHT LIGHTING. PROVIDE TYPEWRITER DIRECTORY CARDS IN EACH PANEL. DENSITY LOADS SERVED BY EACH CIRCUIT BREAKER. PANELBOARDS SHALL BE MANUFACTURED BY GENERAL ELECTRIC, SIEMENS OR SQUARE D.

I. DISCONNECT SWITCHES

1. SWITCHES SHALL BE QUICK-MAKE AND QUICK-BREAK SUCH THAT, DURING NORMAL OPERATION OF THE SWITCH, THE OPERATION OF THE CONTACTS SHALL NOT BE CAPABLE OF BEING RESTRAINED BY THE OPERATING HANDLE AFTER THE CLOSING OR OPENING ACTION OF THE CONTACTS HAS STARTED. SWITCHES SHALL BE HOSPICEPOWER RATED FOR 600 VOLTS AC AND SHALL BE FUSED TYPE WITH DUAL ELEMENT FUSES.

PART 3 - EXECUTION

A. GENERAL:

1. FURNISH ALL REQUIRED HANGERS, CLAMPS, ANCHORS, INSERTS, AND SUPPORTS, INCLUDING SUPPLEMENTARY STEEL FRAMING, NECESSARY FOR THE PROPER INSTALLATION OF THE WORK AND INSTALL IN ACCORDANCE WITH GENERALLY ACCEPTED GOOD PRACTICE.
2. ELECTRICAL EQUIPMENT OR MATERIAL SHALL NOT BE INSTALLED USING HANGERS OR SUPPORTS OF OTHER TRADES.

3. EQUIPMENT RACKS OR SUPPORTS FOR DISCONNECT SWITCHES, ETC., SHALL BE FURNISHED AND INSTALLED AS SHOWN ON THE DRAWINGS OR REQUIRED FOR THE SUPPORT OF EQUIPMENT. RACKS SHALL BE CONSTRUCTED OF STEEL, ANGLE OR CHANNEL AND SHALL BE WALL OR COLUMN SUPPORTED AS REQUIRED.
4. FURNISH AND INSTALL SLEEVES AS REQUIRED OR AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED, RACEWAYS PASSING THROUGH FLOORS SHALL BE GROUDED IN, MAINTAINING THE INTEGRITY OF THE AREA BEING PENETRATED.

5. ALL ELECTRICAL WIRING INSTALLED UNDER THIS PROJECT SHALL BE TESTED FOR CONTINUITY, GROUNDS AND SHORT CIRCUITS BY MEASURING BEFORE ANY EQUIPMENT ARE CONNECTED. FINAL CONNECTIONS OF EQUIPMENT SHALL ALSO BE TESTED FOR CONTINUITY, GROUNDS, AND SHORT CIRCUITS WHEN SO DIRECTED BY THE OWNER. THE CONTRACTOR SHALL DEMONSTRATE BY MEASUR TEST THAT THE INSULATION RESISTANCE OF ANY CIRCUIT IS IN ACCORDANCE WITH THE ICSA REQUIREMENTS FOR THE PARTICULAR TYPE OF INSULATION. WHEN TEST VALUES ARE BELOW THOSE SPECIFIED BY ICSA (LOW READINGS), CORRECT THE FAULT(S) BY REPLACING DEFECTIVE MATERIAL WITH NEW MATERIALS AND DEMONSTRATE BY FURTHER TEST, THE ELIMINATION OF SUCH LOW READINGS. UPON COMPLETION OF TESTING, THE ENTIRE INSTALLATION SHALL THEN BE LEFT FREE OF GROUND AND SHORT CIRCUITS.

6. IDENTIFY ALL CIRCUITS ON THE PANEL LEGEND CARD TO INDICATE THE EQUIPMENT AND LOCATION SERVED.

B. LABELING:

1. PROVIDE AND INSTALL LAMINATED BLACK AND WHITE PHENOLIC NAMEPLATES ON ALL PANELBOARDS, SWITCHBOARDS, SAFETY SWITCHES AND MOTOR STARTERS WITH NONDIMENSIONED ENGRAVED THROUGH THE BLACK OUTER LAYER TO THE WHITE INNER CORE. INDOOR EQUIPMENT SHALL BE LABELED TO MATCH INDIVIDUAL FACILITY STANDARDS, FOR THE FOLLOWING EQUIPMENT: THE NAMEPLATES SHALL INDICATE DESIGNATION OF EQUIPMENT SERVED, LOCATION, PANEL, BREAKER NUMBER FED FROM, VOLTAGE.

2. IDENTIFY ALL CIRCUITS ON THE PANEL LEGEND CARD TO INDICATE THE EQUIPMENT AND LOCATION SERVED.

C. CONDUIT INSTALLATION:

1. CONDUIT ENDS SHALL BE CUT SQUARE AND REAMED. ALL THREADS CUT ON CONDUIT IN THE FIELD SHALL BE CLEAN AND TRUE. FIELD CUT THREADS SHALL BE SUITABLE COATED TO PREVENT RUST. THREAD COATING SHALL NOT INTERFERE WITH ELECTRICAL CONTINUITY OF THE CONDUIT SYSTEM. RUNNING THREAD SHALL NOT BE USED.
2. ALL BEGINS OF CONDUIT SHALL BE DONE WITH AN APPROVED BENDING DEVICE AND ANY CONDUIT CRUSHED OR DEFORMED IN BENDING SHALL BE REJECTED. ALL OFFSETS SHALL BE MADE WITH THE LARGEST RADIUS POSSIBLE (ROLLING OFFSETS SHALL NOT BE ACCEPTABLE). WHEREVER PRACTICAL, MANUFACTURER'S STANDARD ELBOW SHALL BE USED UNLESS OTHERWISE NOTED.

3. ALL CONDUITS WITHIN THE BUILDING SHALL BE RUN CONCEALED WHERE PRACTICABLE AND AS PERMITTED BY BUILDING CODE.
4. ALL EXPOSED CONDUIT AND ALL CONDUIT ABOVE THE HUNG CEILING SHALL BE RUN IN STRAIGHT LINES, AT RIGHT ANGLES TO OR PARALLEL WITH WALLS, JOISTS, BEAMS, DECKERS AND COLUMNS AND SHALL BE SUBSTANTIALLY SUPPORTED BY APPROVED FIRE STRAPS, OR SUITABLE CLAMPS OR HANGERS TO PROVIDE A RIGID INSTALLATION, IN NO CASE SHALL CONDUIT BE SUPPORTED BY BEAMS OR JOISTS. SUCH SUPPORT SHALL BE REMOVED AS SOON AS POSSIBLE OR THE READY REMOVAL OF OTHER FIRE FOR REPAIRS. PERFORATED PIPE HANGERS SHALL NOT BE USED FOR SUPPORTING CONDUIT. CONDUIT, FOR EACH LENGTH OF CONDUIT 1' X 1" AND LARGER MAXIMUM SUPPORT SPACING SHALL BE 8 FEET.

5. ALL CONDUIT RUNS SHALL BE LOCATED SO THAT PULL OR JUNCTION BOXES (NEW OR OLD WORK) WILL BE ACCESSIBLE AND CLEAR OF ALL OBSTRUCTIONS THAT WILL LOCK ACCESS TO SUCH BOXES.
6. ALL EXPOSED CONDUIT RUNS SHALL BE SO INSTALLED AS TO AVOID PIPES, A MINIMUM SEPARATION OF THREE (3) INCHES SHALL BE REQUIRED WHERE CONDUIT RUN IS PARALLEL TO OR ACROSS STRUT, HOT WATER OR CONDENSATE PIPES.

D. WIRE INSTALLATION:

1. THE BEST GAGE SHALL BE EXERCISED WHILE INSTALLING WIRE, CONDUIT, AND/OR DUCTS SO AS NOT TO INJURE THE CONDUCTOR INSULATION. THE WIRE MANUFACTURER'S RECOMMENDATIONS SHALL BE FOLLOWED FOR MINIMUM BENDING RADIUS AND MINIMUM PULLING TENSION. IT IS NECESSARY TO UNWIND THE WIRE IN ORDER TO FACILITATE PULLING THE CONDUCTORS. POWERED SWITCHES OR PULLING-IN COMPOUND SHALL BE USED, NO OILS OR GREASES OF ANY KIND SHALL BE USED FOR THIS PURPOSE. CONDUCTORS SHALL BE CONTINUOUS WITHOUT JOINTS OR SPLICES UNLESS AS PRACTICABLE. THE NECESSARY SPLICES AND/OR TAPS SHALL BE MADE IN PULL BOXES, JUNCTION BOXES AND/OR OUTLET BOXES.

2. CONDUCTORS SHALL PULL THROUGH PULL BOXES, DUCTS, AND/OR CONDUITS IN SUCH A MANNER THAT THEY WILL NOT HAVE SHARP BENDS OR BE DAMAGED BY BEAMS, JOISTS, DECKERS OR CORNERS. THE CONTRACTOR SHALL FURNISH AND USE A FLEXIBLE TUBE WHERE REQUIRED. IT SHALL BE INSURED IN SUCH A MANNER AS TO PREVENT DAMAGE TO THE WIRE BEING PULLED OR TO OTHER WIRE ALREADY INSTALLED IN THE SAME CONDUIT.

3. WIRE/CONDUCTORS SHALL BE PULLED IN USING A NYLON OR POLYPROPYLENE ROPE SPICED TO AN EYE WITH SWIVEL. WHICH SHALL BE ATTACHED TO A STEEL EYE ATTACHED TO THE CONDUCTOR, OR AN ENDLESS BRAIDED CABLE. WIRE SHALL BE PULLED IN USING A PULLING ROPE INSTALLED IN THE SAME MANNER AS THE WIRE.

4. PULLING TENSION OF THE WIRE SHALL BE SUCH THAT THE WIRE WILL NOT BE DAMAGED IN ANY WAY. AT NO TIME SHALL A PULL BE MADE WHICH, IN THE JUDGMENT OF THE PROJECT ENGINEER, WILL PLACE UNDEIR STRAIN ON THE WIRE INSULATION. WIRE SHALL BE PULLED IN SUCH A DIRECTION AS TO MINIMIZE PULLING TENSION, AND SHALL NOT EXCEED VALUES RECOMMENDED BY THE WIRE MANUFACTURER.

E. SPLICES, TAPS, CONNECTIONS, AND TERMINATIONS:

1. CUTTING OR REMOVING INSULATION FROM CONDUCTORS SHALL BE DONE WITH CARE TO AVOID NICKING STRANDS OR THE CONDUCTOR OF A SOLID CONDUCTOR SHALL BE REMOVED BY USING A FENELING TOOL.
2. SPLICES, TAPS, OR CONNECTIONS IN NO. 8 AWG AND SMALLER SHALL BE MADE WITH TIN-PLATED COPPER, INSULATED, COMPRESSION CONNECTORS OR INSULATED SPRING CONNECTORS AS MANUFACTURED BY THE FOLLOWING OR APPROVED EQUAL:
 - A. ELECTRICAL PRODUCTS DIVISION 3M (SCOTCHLOCK)
 - B. IDEAL INDUSTRIES
 - C. THOMAS AND BETTS

3. SPLICES, TAPS, AND CONNECTIONS IN NO. 8 AWG AND LARGER SHALL BE MADE WITH TIN-PLATED, HIGH CONDUCTIVITY, COPPER COMPRESSION OR CAST, HIGH CONDUCTIVITY, HIGH STRENGTH, COPPER ALLOY, BOLT-TYPE CONNECTORS AS MANUFACTURED BY THE FOLLOWING OR APPROVED EQUAL:
 - A. BURNIT ENGINEERING CO.
 - B. DOSSERT MFG. CO.
 - C. THOMAS AND BETTS
 - D. POLARIS

4. UNLESS SPECIFIED OTHERWISE ALL WIRE SPLICES OR TAPS IN NO. 8 AWG OR LARGER CONDUCTORS SHALL BE INSULATED EITHER BY TYPING OR BY USE OF SPRING-HELD GAWMS BANGLETTE COVERS DESIGNED TO FIT AROUND AND OVER SPLICE OR TAP, OR UL LISTED SELF INSULATED COMPRESSION BOLT TYPE CONNECTORS.

5. INSULATION OF SPICE OR TAP SHALL BE, AT A MINIMUM, EQUAL TO THE WIRE INSULATION. WHEN TAPE IS USED CONNECTIONS SHALL BE FIRST BUILT UP WITH ELECTRICAL INSULATION PUTTY TO ELIMINATE BOTH SHARP CORNERS AND VOIDS, THEN FINAL UNIFORM COATING OF VINYL PLASTIC TAPE OF AT LEAST 4 LAYERS (HALF-LAPPED IN TWO (2) DIRECTIONS) SHALL BE APPLIED.

6. VINYL PLASTIC TAPE AND INSULATING PUTTY SHALL BE "SCOTCH TAPE NO. 88" AND "SCOTCHGEL" AS MANUFACTURED BY THE 3M COMPANY.
7. BANGLETTE SPLICE COVERS SHALL BE DESIGNED AND RATED FOR USE WITH 600 VOLT CIRCUITS, AND BE AS MANUFACTURED BY O.E. ELECTRICAL MANUFACTURING CO., PUL PRODUCTS, INC. OR APPROVED EQUAL, AND SHALL HAVE A VOLTAGE RATING EQUAL TO THE WIRE INSULATION RATING.

F. PULL BOXES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING PULL BOXES IN ANY CONDUIT RUN WHERE EXCESSIVE STRESS MAY BE PLACED ON THE CABLE OR WIRE DURING THE PULLING OPERATION. IF IN THE OPINION OF THE OWNER (PROJECT ENGINEER) A CONDUIT RUN IS TOO LONG OR CONTAINS TOO MANY BENDS FOR ONE CONTINUOUS PULL, THE CONTRACTOR SHALL AND THE NECESSARY PULL BOXES TO REDUCE THE PULLING STRESS. PULL BOXES SHALL BE INSTALLED PER THE NEC AND AS FOLLOWS WHOEVER IS MORE STRINGENT.

- a. 100 FEET-FOR STRAIGHT RUNS
- b. 100 FEET-FOR RUNS WITH ONE 90 DEGREE BEND OR EQUIVALENT
- c. 75 FEET-FOR RUNS WITH MORE THAN TWO 90 DEGREE BENDS OR EQUIVALENT

G. GROUNDING AND BONDING:

1. IT IS THE INTENT OF THIS SPECIFICATION TO REQUIRE A COMPLETE AND CONTINUOUS GROUNDING SYSTEM TO PROVIDE AN ADEQUATE PATH FOR GROUND FAULT CURRENTS AND TO PROVIDE SAFETY TO PERSONNEL FROM ACCIDENTAL ELECTRIC SHOCK HAZARDS.

2. GROUND ALL SYSTEMS SHOWN ON THE DRAWINGS, AS SPECIFIED, AND AS REQUIRED BY NATIONAL AND LOCAL CODES.
3. GROUNDING SHALL BE BY MEANS OF A GROUND WIRE IN CABLES AND RACEWAYS. AN EQUIPMENT GROUND CONDUCTOR SHALL BE PROVIDED IN EACH RACEWAY AND CABLE ASSEMBLY. INSULATED GROUND CONDUCTORS SHALL BE COLORED GREEN, WHERE GROUND WIRES ARE NOT SHOWN ON THE DRAWINGS IN CONDUITS THE CONTRACTOR SHALL UNDERSTAND THAT IT IS A REQUIREMENT TO PROVIDE A CODE SIZED GROUND WIRE AS SPECIFIED ABOVE.

4. IN ADDITION TO THE ABOVE, CONDUITS SHALL BE EFFECTIVELY GROUNDED TO THE METAL FRAMEWORK OF PANELBOARDS, SWITCHES, MOTORS, STARTERS, AND JUNCTION BOXES BY MEANS OF GROUNDING BUSHINGS AND BONDING JUMPERS.

5. THE EQUIPMENT GROUND CONDUCTOR SHALL BE CONNECTED TO EQUIPMENT GROUND BUS OF SWITCHGEAR, PANELBOARDS, AND SUCH OTHER EQUIPMENT HAVING A GROUND BUS. CONNECT THE EQUIPMENT GROUND CONDUCTOR TO THE GROUND LUG IN JUNCTION BOXES, PULL BOXES AND OTHER ENCLOSURES NOT EQUIPPED WITH A GROUND BUS.
6. THE EQUIPMENT GROUND CONDUCTOR SHALL BE CONNECTED TO THE METAL FRAME OF MOTORS WITH A BOLTED SOLDERLESS LUG.

7. GROUND CONDUCTORS, OR BONDING JUMPERS, SHALL BE SIZED IN ACCORDANCE WITH