

SECTION 16B BASIC ELECTRICAL MATERIALS AND METHODS (CONT.)

16B-1-2 RACEWAY INSTALLATION

INSTALL ALL CIRCULAR RACEWAYS CONCEALED ABOVE SUSPENDED CEILINGS OR CONCEALED IN WALLS OR FLOORS WHEREVER POSSIBLE EXCEPT WHERE OTHERWISE INDICATED.

PROVIDE GRS FOR ALL CONDUITS RUN UNDERGROUND, EXPOSED TO WEATHER, OR EXPOSED TO OTHER HAZARDOUS CONDITIONS. PROVIDE GRS INSTALLED BELOW GRADE WITH A CORROSION RESISTANT BONDING PLASTIC OR APPROVED MASTIC COATING. THIS SHALL INCLUDE THE 90-DEGREE ELBOW BELOW GRADE AND THE ENTIRE VERTICAL TRANSITION TO ABOVE GRADE.

ALL OTHER RACEWAY MAY BE EMT WHERE APPROVED BY LOCAL CODE. USE COMPRESSION TYPE FITTINGS FOR EMT, WITH ALL FITTINGS UL LISTED FOR THE ENVIRONMENT IN WHICH THEY ARE USED.

AT CONTRACTOR'S OPTION, PVC CONDUIT MAY BE USED UNDERGROUND WHERE PERMITTED BY LOCAL CODE AND WHERE NOT SPECIFICALLY RESTRICTED BY THESE DOCUMENTS. WHEN USED, PROVIDE COATED GRS, AS SPECIFIED ABOVE, FOR ALL BENDS GREATER THAN 30 DEGREES, INCLUDING THE 90-DEGREE ELBOWS BELOW GRADE AND THE ENTIRE VERTICAL RISERS FOR TRANSITIONS FROM BELOW TO ABOVE GRADE OR ABOVE-SLAB.

USE FMC FOR FINAL CONNECTION TO EACH MOTOR AND TRANSFORMER, AND TO ANY DEVICE THAT WOULD OTHERWISE TRANSMIT MOTION, VIBRATION, OR NOISE. USE LFMC WHERE EXPOSED TO LIQUIDS, VAPORS OR SUNLIGHT. PROVIDE ALL FMC AND LFMC WITH AN INSULATED BONDING CONDUCTOR.

USE ONLY METAL RACEWAYS FOR ALL POWER WIRING FROM THE OUTPUT OF VARIABLE FREQUENCY DRIVES TO THEIR RESPECTIVE MOTORS.

INSTALL RACEWAYS PARALLEL AND PERPENDICULAR TO BUILDING LINES.

INSTALL RACEWAYS TO REQUIREMENTS OF STRUCTURE AND TO REQUIREMENTS OF ALL OTHER WORK ON THE PROJECT. INSTALL RACEWAY TO CLEAR ALL OPENINGS, DEPRESSIONS, PIPES, DUCTS, REINFORCING STEEL, AND OTHER IMMOVABLE OBSTACLES. INSTALL RACEWAYS SET IN FORMS FOR CONCRETE STRUCTURE IN SUCH A MANNER THAT INSTALLATION WILL NOT AFFECT THE STRENGTH OF THE STRUCTURE. EXCEPT WHERE APPROVED IN WRITING BY THE ENGINEER, INSTALL NO RACEWAY IN A SLAB-ON-GRADE. LOCATE RACEWAY BELOW GRANULAR FILL BELOW SLABS-ON-GRADE.

INSTALL RACEWAYS CONTINUOUS BETWEEN CONNECTIONS TO OUTLETS, BOXES AND CABINETS WITH A MINIMUM POSSIBLE NUMBER OF BENDS AND NOT MORE THAN THE EQUIVALENT OF FOUR 90-DEGREE BENDS BETWEEN CONNECTIONS. USE MANUFACTURED ELBOWS FOR ALL 45- AND 90-DEGREE BENDS, UNLESS APPROVED BY THE ENGINEER IN ADVANCE. MAKE OTHER BENDS SMOOTH AND EVEN AND WITHOUT FLATTENING RACEWAY OR FLAKING GALVANIZING OR ENAMEL. RADI OF BENDS SHALL BE AS LONG AS POSSIBLE AND NEVER SHORTER THAN THE CORRESPONDING TRADE ELBOW. USE LONG RADIUS ELBOWS WHERE NECESSARY, INDICATED, OR BOTH.

SECURELY FASTEN RACEWAYS IN PLACE WITH APPROVED STRAPS, HANGERS AND STEEL SUPPORTS AS REQUIRED. ATTACH RACEWAY SUPPORTS TO THE BUILDING STRUCTURE. HANG SINGLE RACEWAYS FOR FEEDERS WITH MALLEABLE SPLIT RING HANGERS WITH ROD AND TURNBUCKLE SUSPENSION FROM INSERTS SPACED NOT OVER 10 FEET APART IN CONSTRUCTION ABOVE. CLAMP GROUPS OF HORIZONTAL FEEDER RACEWAYS TO STEEL CHANNELS THAT ARE SUSPENDED FROM INSERTS SPACED NOT OVER 10 FEET APART IN CONSTRUCTION ABOVE. SECURELY CLAMP VERTICAL FEEDER RACEWAYS TO STRUCTURAL STEEL MEMBERS ATTACHED TO STRUCTURE. INSTALL CABLE CLAMPS FOR SUPPORT OF VERTICAL FEEDERS WHERE REQUIRED. ADD RACEWAY SUPPORTS WITHIN 12 INCHES OF ALL BENDS, ON BOTH SIDES OF THE BENDS. DO NOT SUPPORT RACEWAYS FROM SUSPENDED CEILING COMPONENTS.

REAM RACEWAY ENDS, THOROUGHLY CLEAN RACEWAYS BEFORE INSTALLATION, AND KEEP CLEAN AFTER INSTALLATION. PLUG OR COVER OPENINGS AND BOXES AS REQUIRED TO KEEP RACEWAYS CLEAN DURING CONSTRUCTION AND FISH ALL RACEWAYS CLEAR OF OBSTRUCTIONS BEFORE PULLING CONDUCTORS WIRES. PROVIDE RACEWAYS OF AMPLE SIZE FOR PULLING OF WIRE AND NOT SMALLER THAN CODE REQUIREMENTS AND NOT LESS THAN 1/2-INCH IN SIZE, UNLESS INDICATED OTHERWISE ON DRAWINGS.

PROTECT ALL RACEWAY INSTALLATIONS AGAINST DAMAGE DURING CONSTRUCTION. REPAIR ALL RACEWAYS DAMAGED OR MOVED OUT OF LINE AFTER ROUGHING-IN TO MEET ENGINEER'S APPROVAL WITHOUT ADDITIONAL COST TO THE OWNER.

ALIGN AND INSTALL TRUE AND PLUMB ALL RACEWAY TERMINATIONS AT PANELBOARDS, SWITCHBOARDS, MOTOR CONTROL EQUIPMENT AND JUNCTION BOXES.

INSTALL APPROVED EXPANSION/DEFLECTION FITTINGS WHERE RACEWAYS PASS THROUGH (IF EMBEDDED) OR ACROSS (IF EXPOSED) EXPANSION JOINTS.

INSTALL A PULL WIRE IN EACH EMPTY RACEWAY THAT IS LEFT FOR INSTALLATION OF CONDUCTORS OR CABLES UNDER OTHER DIVISIONS OR CONTRACTS. USE POLYPROPYLENE OR MONOFILAMENT PLASTIC LINE WITH NOT LESS THAN 200-LB TENSILE STRENGTH. LEAVE AT LEAST 24 INCHES OF SLACK AT EACH END OF PULL WIRE.

MAKE ALL JOINTS AND CONNECTIONS IN A MANNER THAT WILL ENSURE MECHANICAL STRENGTH AND ELECTRICAL CONTINUITY.

EFFECTIVELY SEAL RACEWAYS, BY INSTALLING A CONDUIT FITTING AT THE BOUNDARY OF THE TWO SPACES, AND FILLING IT WITH AN APPROVED PLIABLE MATERIAL, AFTER CONDUCTORS OR CABLES HAVE BEEN INSTALLED AND TESTED, WHEN EVER:

- 1. RACEWAYS PASS FROM NON-COOLED TO COOLED SPACES.
2. RACEWAYS TRANSITION FROM OUTSIDE A FACILITY OR ENCLOSURE TO INSIDE, WHETHER BURIED OR EXPOSED.

16B-1-3 BUSHINGS AND LOCKNUTS

RIGIDLY TERMINATE CONDUITS ENTERING SHEET METAL ENCLOSURES TO THE ENCLOSURE WITH A BUSHING AND LOCKNUT ON THE INSIDE AND A LOCKNUT OR AN APPROVED HUB ON THE OUTSIDE. CONDUIT SHALL ENTER THE ENCLOSURE SQUARELY.

PROVIDE BUSHINGS AND LOCKNUTS MADE OF GALVANIZED MALLEABLE IRON WITH SHARP, CLEAN-CUT THREADS.

WHERE EMT ENTERS A BOX, PROVIDE APPROVED EMT COMPRESSION CONNECTORS.

USE INSULATED, GROUNDING, OR COMBINATION, BUSHINGS WHEREVER CONNECTION IS SUBJECT TO VIBRATION OR MOISTURE, WHEN REQUIRED BY NFPA 70, OR BOTH.

16B-1-4 CONDUCTORS AND CABLES

CONDUCTOR MATERIAL:

- 1. SERVICE LATERALS AND PANELBOARD FEEDERS:
A. ANNEALED (SOFT) COPPER COMPLYING WITH ICEA 5-95-65B/NEMA WC70; SOLID CONDUCTOR FOR NO. 10 AWG AND SMALLER; CONCENTRIC, COMPRESSED STRANDED FOR NO. 8 AWG AND LARGER (NO EXCEPTIONS)
B. COMPACT STRANDED, ALUMINUM ALLOY (AA-8000 SERIES), COMPLYING WITH ICEA 5-95-65B/NEMA WC70; NO. 2 AWG OR OR LARGER ONLY. ALCAN STABLOY OR APPROVED EQUIVALENT.
2. ALL BRANCH CIRCUIT ANNEALED (SOFT) COPPER COMPLYING WITH ICEA 5-95-65B/NEMA WC70; SOLID CONDUCTOR FOR NO. 10 AWG AND SMALLER; CONCENTRIC, COMPRESSED STRANDED FOR NO. 8 AWG AND LARGER (NO EXCEPTIONS)
3. CONDUCTOR INSULATION TYPES: 90-DEGREE C-RATED, TYPE THHN/THWN-2 OR XHHW-2 COMPLYING WITH ICEA 5-95-65B/NEMA WC70.
4. SIZES OF CONDUCTORS AND CABLES INDICATED OR SPECIFIED ARE IN AMERICAN WIRE GAGE (AWG - BROWN AND SHARPE).
5. UNLESS INDICATED OTHERWISE, SPECIAL PURPOSE CONDUCTORS AND CABLES, SUCH AS LOW VOLTAGE CONTROL AND SHIELDED INSTRUMENT WIRING, SHALL BE AS RECOMMENDED BY THE SYSTEM EQUIPMENT MANUFACTURER.

ALL FEEDER AND BRANCH CIRCUIT CONDUCTORS NO. 8 AWG AND LARGER: STRANDED, TYPE THWN-2 OR XHHW-2 INSULATION.

ALL CONDUCTORS, NO. 10 AWG AND SMALLER, USED FOR POWER AND LIGHTING CIRCUITS: SOLID COPPER, TYPE THWN-2 (WET OR DAMP LOCATIONS, OR IN CONDUIT BELOW GRADE OR SLAB), TYPE THHN (DRY LOCATIONS ONLY AND ABOVE GRADE) INSULATION, OR DUAL-RATED TYPE THHN/THWN-2.

ALL BRANCH CIRCUIT WIRING: NOT SMALLER THAN NO. 12 AWG. IF NO CONDUCTOR SIZE IS INDICATED ON THE DRAWINGS FOR A BRANCH CIRCUIT, PROVIDE CONDUCTORS AND CONDUIT SIZED PER NFPA 70 AND BASED ON THE INDICATED BRANCH CIRCUIT OVERCURRENT PROTECTIVE DEVICE (OCPD) RATING AND NUMBER OF POLES. WHERE NO CIRCUIT SIZE (I.E., CONDUCTORS AND OCPD) IS INDICATED ON THE DRAWINGS FOR A BRANCH CIRCUIT, PROVIDE THREE NO. 12 AWG CONDUCTORS, IN 3/4-INCH RACEWAY, AND A 20A CIRCUIT BREAKER.

CONDUCTORS FIELD-INSTALLED WITH FLOUORESCENT LIGHT FIXTURE CHANNELS: TYPE THHN.

CONTROL WIRING: STRANDED COPPER CONDUCTORS, 600V INSULATION, OF THE PROPER TYPE, SIZE AND NUMBER AS REQUIRED TO ACCOMPLISH SPECIFIED FUNCTION. MINIMUM SIZE: NO. 14 AWG, UNLESS NOTED OTHERWISE.

TYPE MC CABLE: 600V, UNJACKETED; ANSI E119 AND E814, UL STANDARDS 44 OR 83 (AS APPLICABLE), AND 1569, NFPA 70 ARTICLE 330; ALUMINUM OR GALVANIZED STEEL INTERLOCKED ARMOR; THHN- OR XHHW-INSULATED CONDUCTORS; COLOR CODE: ICEA METHOD 1, WITH GREEN INSULATED GROUNDING CONDUCTOR

16B-1-5 INSTALLATION OF CONDUCTORS AND CABLES

INSTALL ALL WIRING IN APPROVED RACEWAY AND ENCLOSURES, EXCEPT WHERE SPECIFIED OR INDICATED, FOR LOW-VOLTAGE WIRING OR, WHERE TYPE MC CABLE IS SPECIFIED AS ACCEPTABLE.

SUPPORT ALL CONDUCTORS AND CABLES IN VERTICAL INSTALLATIONS, AS REQUIRED BY NFPA 70, BY INSTALLING CABLE SUPPORTS OR PLUG-TYPE CONDUIT RISER SUPPORTS, OR WIRE-MESH SAFETY GRIPS.

INSTALL ALL CONDUCTORS AND CABLE IN RACEWAYS CONTINUOUS WITHOUT TAPS OR SPLICES. SPLICE OR TAP ONLY IN APPROVED BOXES AND ENCLOSURES WITH APPROVED SOLDERLESS CONNECTORS, OR CRIMP CONNECTORS AND TERMINAL BLOCKS FOR CONTROL WIRING, AND KEEP TO THE MINIMUM REQUIRED. INSULATE ALL SPLICES, TAPS, AND JOINTS AS REQUIRED BY CODES.

ALL MATERIALS USED TO TERMINATE, SPLICE OR TAP CONDUCTORS: DESIGNED FOR, PROPERLY SIZED FOR, AND UL LISTED FOR THE SPECIFIC APPLICATION AND CONDUCTORS INVOLVED, AND INSTALLED IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS, USING THE MANUFACTURER'S RECOMMENDED TOOLS.

WHERE WIRING IS INDICATED AS INSTALLED, BUT THE CONNECTION IS INDICATED "FUTURE" OR "BY OTHER DIVISION, TRADES, OR CONTRACTS", LEAVE A MINIMUM 3-FOOT "PIGTAIL" AT THE BOX, TAPE THE ENDS OF THE CONDUCTORS, AND COVER THE BOX.

THE NUMBER OF CONDUCTORS IN A SPECIFIC RACEWAY "HOME RUN" IS INDICATED WITH CROSS LINES (TICK MARKS) ON EACH "CIRCUIT RUN" ON THE DRAWINGS. IN GENERAL, THE DIRECTION OF BRANCH CIRCUIT "HOME RUN" ROUTING IS INDICATED ON THE DRAWINGS, COMPLETE WITH CIRCUIT NUMBERS AND PANELBOARD DESIGNATION. CONTINUE ALL SUCH "HOME RUN" WIRING TO THE DESIGNATED PANELBOARD, AS THOUGH "CIRCUIT RUNS" WERE INDICATED IN THEIR ENTIRETY.

WHEN MULTIPLE HOME RUNS ARE COMBINED INTO A SINGLE RACEWAY SUCH THAT THE NUMBER OF CONDUCTORS EXCEEDS FOUR (CONDUCTOR COUNT IS MADE UP OF ANY COMBINATION OF PHASE AND NEUTRAL CONDUCTORS), THE FOLLOWING RESTRICTIONS APPLY, WHICH ARE IN ADDITION TO THOSE IN NFPA 70:

- 1. NORMAL OR NON-ESSENTIAL CIRCUITS.
A. MAXIMUM OF 16 CONDUCTORS IN A SINGLE RACEWAY. FOR UP TO EIGHT CONDUCTORS IN A RACEWAY, MINIMUM RACEWAY SIZE: 3/4-INCH. FOR GREATER THAN EIGHT CONDUCTORS, MINIMUM RACEWAY SIZE: 1-INCH. DO NOT INSTALL ANY OTHER TYPE OF CIRCUIT IN THIS RACEWAY.
B. THE MINIMUM WIRE SIZE FOR ALL CONDUCTORS IN THIS RACEWAY: NO. 10 AWG.
C. ONLY 15A AND 20A BRANCH CIRCUIT HOMERUNS MAY BE COMBINED INTO ONE RACEWAY.
2. GFCI CIRCUITS. - DO NOT USE MULTI-CONDUCTOR CIRCUITS, WITH A SHARED NEUTRAL, OR ANY GFCI CIRCUIT BREAKER OR RECEPTACLE CIRCUIT.

FOR BRANCH CIRCUITS FED FROM GFCI CIRCUIT BREAKERS, LIMIT THE ONE-WAY CONDUCTOR LENGTH TO 100 FEET BETWEEN THE PANELBOARD AND THE MOST REMOTE RECEPTACLE OR LOAD ON THE GFCI CIRCUIT.

WIRING SHALL HAVE INSULATION OF THE PROPER COLOR TO MATCH COLOR CODE SYSTEM IN THE TABLE BELOW. IN LARGER SIZES, WHERE PROPERLY COLORED INSULATION IS NOT AVAILABLE, USE VINYL PLASTIC ELECTRICAL TAPE OF THE APPROPRIATE COLOR AROUND EACH CONDUCTOR AT ALL TERMINATION POINTS, JUNCTION AND PULL BOXES.

Table with columns: System Voltage, Conductor Type, Color. Rows include 208Y/120, Phase A (Black), Phase B (Red), Phase C (Blue), Neutral (White), Equipment Ground (Green), Isolated Ground (Green w/yellow stripe).

TYPE MC CABLE MAY ONLY BE USED: IN LIEU OF FLEXIBLE CONDUIT AND WIRING FROM LIGHT FIXTURES IN ACCESSIBLE CEILINGS TO JUNCTION BOXES (ATTACHED TO BUILDING STRUCTURE) ABOVE THE CEILING. PROVIDE CABLE WHIPS OF SUFFICIENT LENGTHS TO ALLOW FOR RELOCATING EACH LIGHT FIXTURE WITHIN A 5-FOOT RADIUS OF ITS INSTALLED LOCATION, BUT NOT EXCEEDING 6 FEET IN UNSUPPORTED LENGTHS.

PROPERLY IDENTIFY ALL TERMINAL BLOCKS AND WIRE TERMINALS FOR CONTROL WIRING WITH VINYL STICK-ON MARKERS OR EQUIVALENT. PROVIDE ENGINEER WITH A LIST OF PROPOSED IDENTIFYING NUMBERS FOR REVIEW PRIOR TO INSTALLING MARKERS.

PROVIDE AN EQUIPMENT-GROUNDING CONDUCTOR, OR BONDING JUMPER, AS APPLICABLE, IN ALL BRANCH CIRCUITS AND FEEDERS, SIZED IN ACCORDANCE WITH NFPA 70 TABLES 250.66 OR 250.122, AS APPLICABLE, UNLESS INDICATED AS LARGER ON THE DRAWINGS.

VOLTAGE DROP IN BRANCH CIRCUITS SHALL NOT EXCEED 2 PERCENT.

16B-1-6 JUNCTION BOXES, PULL BOXES, CABINETS AND WIREWAYS

PROVIDE JUNCTION BOXES, PULL BOXES, CABINETS AND WIREWAYS WHEREVER NECESSARY FOR PROPER INSTALLATION OF VARIOUS ELECTRICAL SYSTEMS ACCORDING TO NFPA 70 AND WHERE INDICATED ON THE DRAWINGS. SIZE AS REQUIRED FOR THE SPECIFIC FUNCTION OR AS REQUIRED BY NFPA 70, WHICHEVER IS LARGER. CONSTRUCTION SHALL BE OF A NEMA DESIGN SUITABLE FOR THE ENVIRONMENT INSTALLED.

16B-1-7 OUTLET BOXES

ALL OUTLETS INCLUDING LIGHT FIXTURE, SWITCH, RECEPTACLE, AND SIMILAR OUTLETS: NATIONAL ELECTRICAL, APPLITION, STEEL CITY, RACO, OR APPROVED EQUAL, GALVANIZED STEEL KNOCKOUT BOXES, SUITABLE IN DESIGN TO THE PURPOSE THEY SERVE AND THE SPACE THEY OCCUPY. SIZE AS REQUIRED FOR THE SPECIFIC FUNCTION OR AS REQUIRED BY NFPA 70, WHICHEVER IS LARGER. SET ALL OUTLET BOXES IN WALLS, COLUMNS, FLOORS, OR CEILINGS SO THEY ARE FLUSH WITH THE FINISHED SURFACE, ACCURATELY SET, AND RIGIDLY SECURED IN POSITION. PROVIDE PLASTER RINGS, EXTENSION RINGS AND/OR MASONRY RINGS AS REQUIRED FOR FLUSH MOUNTING. PROVIDE APPROVED CAST OUTLET BOXES, WITH HUBS AND WEATHER-PROOF COVERS, IN ALL AREAS SUBJECT TO DAMP, WET, OR HARSH CONDITIONS.

16B-1-8 OUTLET LOCATIONS

COORDINATE LOCATIONS OF OUTLET BOXES. OUTLETS ARE ONLY APPROXIMATELY LOCATED ON THE SMALL SCALE DRAWINGS. USE GREAT CARE IN THE ACTUAL LOCATION BY CONSULTING THE VARIOUS LARGE SCALE DETAILED DRAWINGS USED BY OTHER DIVISION TRADES, AND BY SECURING DEFINITE LOCATIONS FROM THE ARCHITECT.

16B-1-9 MOUNTING HEIGHTS

UNLESS NOTED OTHERWISE, INSTALL WIRING DEVICES AS INDICATED BELOW (NOTE: ALL DIMENSIONS ARE TO THE BOTTOM OF THE OUTLET BOX UNLESS NOTED OTHERWISE):

RECEPTACLES:

- 1. GENERAL:
A. VERTICALLY WITH THE GROUND SLOT MOUNTED AT THE TOP: 16 INCHES ABOVE FINISHED FLOOR.
B. HORIZONTALLY, WITH NEUTRAL SLOT MOUNTED AT THE TOP: 16 INCHES ABOVE FINISHED FLOOR.
2. ABOVE COUNTERS:
A. FOR 36-INCH HIGH COUNTER TOPS: 44 INCHES ABOVE FINISHED FLOOR, VERTICALLY.
B. FOR 34-INCH HIGH COUNTER TOPS: 40 INCHES ABOVE FINISHED FLOOR, VERTICALLY.
3. MECHANICAL AND ELECTRICAL EQUIPMENT ROOMS AND JANITORS CLOSETS: 44 INCHES ABOVE FINISHED FLOOR, VERTICALLY.

4. WEATHERPROOF EXTERIOR RECEPTACLES: 24 INCHES ABOVE FINISHED GRADE, HORIZONTALLY.

5. GFCI RECEPTACLES: SAME AS GENERAL RECEPTACLES.

6. ISOLATED GROUND RECEPTACLES: SAME AS GENERAL RECEPTACLES.

7. CONCRETE BLOCK WALLS: DIMENSIONS ABOVE MAY BE ADJUSTED SLIGHTLY, AS REQUIRED TO COMPENSATE FOR VARIABLE JOINT DIMENSIONS, SUCH THAT BOTTOM OR TOP OF BOXES, AS APPLICABLE, ARE AT BLOCK JOINTS.

SWITCHES:

- 1. GENERAL: 44 INCHES ABOVE FINISHED FLOOR.
2. ABOVE COUNTERS: SAME AS FOR RECEPTACLES.
3. CONCRETE BLOCK WALLS: 40 INCHES ABOVE FINISHED FLOOR (DIMENSION MAY BE ADJUSTED SLIGHTLY, AS REQUIRED TO COMPENSATE FOR VARIABLE JOINT DIMENSIONS, SUCH THAT BOTTOM OF BOXES ARE AT BLOCK JOINTS).

4. WALLS WITH WAINSCOTING: 6 INCHES MINIMUM ABOVE WAINSCOTING, BUT NOT EXCEEDING 48 INCHES ABOVE FINISHED FLOOR.

TELEPHONE/DATA OUTLET BOXES:

- 1. GENERAL: MATCH MOUNTING HEIGHT OF ADJACENT WIRING DEVICE LISTED ABOVE.
2. WALL-MOUNTED TELEPHONE: 40 INCHES ABOVE FINISHED FLOOR.
3. FOR OTHER THAN WIRING DEVICES, REFER TO PARAGRAPHS, ARTICLES, SECTIONS, DIVISIONS, OR DRAWINGS TO OBTAIN MOUNTING HEIGHTS FOR SPECIFIC EQUIPMENT OR SYSTEMS.

16B-1-10 WIRING DEVICES

PROVIDE THE FOLLOWING WIRING DEVICES WHERE SHOWN ON DRAWINGS OR REQUIRED. MINOR CHANGES RELATIVE TO THE LOCATION OF ELECTRICAL EQUIPMENT MAY BE MADE TO COMPLY WITH STRUCTURAL AND BUILDING REQUIREMENTS AS DETERMINED IN THE COURSE OF CONSTRUCTION. PROVIDE ALL WIRING DEVICES OF THE SAME MANUFACTURER AND NOT MIXED ON THE PROJECT, TO THE MAXIMUM EXTENT POSSIBLE. PROVIDE COLOR OF TOGGLES AND RECEPTACLES AS REQUESTED BY THE ENGINEER:

Table with columns: Type of Device, Hubbell, Pass & Seymour, Leviton, Cooper Wiring Devices. Rows include Simplex Receptacle, Duplex Receptacle, GFCI Receptacle, Isolated Ground Receptacle, Single Pole Switch, Three-way Switch, Four-way Switch, Wall-box Dimmer, Incandescent Momentary SPDT, Center-Off Switch.

16B-1-11 SWITCH AND OUTLET COVER PLATES

SWITCH AND OUTLET PLATES: SATIN STAINLESS STEEL, SMOOTH NYLON, BY THE SAME MANUFACTURER AS THE WIRING DEVICES, WHEREVER POSSIBLE. VERIFY DESIRED MATERIALS AND COLORS WITH ENGINEER BEFORE INSTALLATION. SWITCH PLATES IN UNFINISHED ROOMS AND SPACES: PLATED STEEL, CADMIUM PLATED. INSTALL GROUPS OF SWITCHES UNDER ONE GANGED-STAMP, USUALLY HORIZONTALLY; OR, WHERE REQUIRED BY DETAILS, VERTICALLY. SET ALL COVER PLATES PLUMB, PARALLEL, AND FINISHED FLUSH WITH THE WALL.

16B-1-12 WEATHERPROOF COVER PLATES

PROVIDE GFCI RECEPTACLES FOR DESIGNATED WEATHERPROOF RECEPTACLES, UNLESS INDICATED OTHERWISE ON THE DRAWINGS.

FOR UNATTENDED, WET LOCATIONS: IN-USE NEMA 3R, UL-LABELED PLATES MOLDED FROM A CLEAR HIGH IMPACT ULTRAVIOLET STABILIZED POLYCARBONATE MATERIAL FOR EASY VERIFICATION THAT CORDS ARE PLUGGED IN AND THAT THE GFCI IS FUNCTIONING.

COVER PLATES: BY THE SAME MANUFACTURER AS THE WIRING DEVICES, COMPLYING WITH NFPA 70 406.8 (A) OR (B) REQUIREMENTS FOR ATTENDED OR UNATTENDED USE AS APPLICABLE.

16B PART 2 ELECTRICAL SERVICE AND GROUNDING

16B 2-1 ELECTRICAL SERVICE

SEE DRAWINGS FOR TYPE, SIZE, VOLTAGE, PHASE, AND OTHER REQUIREMENTS.

ROVIDE, OR ARRANGE WITH THE SERVING UTILITY FOR INSTALLATION TO PROVIDE, A FLOORING VOLTMEETER AT THE SERVICE POINT, ON THE FIRST DAY THE FACILITY IS OPEN FOR BUSINESS; FOR A 24-HOUR VOLTAGE TEST. IF THE REQUIREMENTS OF ALL CODES ARE NOT WITHIN ACCEPTABLE LIMITS, ARRANGE WITH THE UTILITY FOR PROPER VOLTAGE. SUBMIT TO THE OWNER A REPORT OF MAXIMUM AND MINIMUM VOLTAGE AND A COPY OF THE RECORDING VOLTMEETER CHART.

16 2-2 CONNECTION TO SERVING UTILITIES

PROVIDE RACEWAYS, TERMINATIONS, METERING PROVISIONS, AND MISCELLANEOUS EQUIPMENT, AS REQUIRED, FOR ELECTRICAL AND TELEPHONE SERVICES FOR CONNECTION BY THE SERVING UTILITY, IN STRICT COMPLIANCE WITH ALL LOCAL, STATE AND FEDERAL APPLICABLE CODES AND OF THE SERVING UTILITY INVOLVED. VERIFY ALL SERVICE TERMINATIONS AND CONNECTION POINTS IN THE FIELD AND WORK IN CONJUNCTION WITH THE UTILITY INVOLVED IN THE INSTALLATION OF ALL SERVICES. PROVIDE ALL MATERIALS AND EQUIPMENT REQUIRED FOR COMPLETE UTILITY CONNECTION BUT NOT FURNISHED BY THE SERVING UTILITY. NOTIFY THE UTILITY COMPANIES INVOLVED WITHIN TWO WEEKS AFTER NOTICE TO PROCEED, OF ALL REQUIRED INFORMATION NECESSARY FOR THE UTILITY TO SUPPLY THE PROJECT WITHOUT DELAY. PAY ALL CHARGES OF THE SERVING UTILITY FOR THE ELECTRICAL SERVICE(S).

16B 2- GROUNDING

PERMANENTLY AND EFFECTIVELY GROUND AND BOND THE ELECTRICAL INSTALLATION IN A THOROUGH AND EFFICIENT MANNER, AND IN CONFORMANCE, AT A MINIMUM, WITH NFPA 70, OR THESE DOCUMENTS, WHERE THEY EXCEED CODE REQUIREMENTS. USE BARE OR INSULATED CONDUCTORS, AS SPECIFIED HEREIN, AND OTHER MATERIALS INDICATED ON THE DRAWINGS.

16B PARTS DISTRIBUTION AND CONTROL EQUIPMENT

16B 3-1 MODULAR METER CENTERS

MODULAR METER CENTERS: SQUARE D TYPE EZ METER-PAK, OR APPROVED EQUAL BY SIEMENS, CUTLER-HAMMER, OR GENERAL ELECTRIC, COMPLETE WITH THREE-PHASE/FOUR-WIRE INTEGRAL BUS, INDIVIDUAL THREE-POLE CURRENT LIMITING CIRCUIT BREAKER FOR EACH MODUL, METER SOCKETS COMPATIBLE WITH UTILITY COMPANY METERS. WEATHERPROOF CONSTRUCTION, AND MAIN CIRCUIT BREAKER. PROVIDE CENTERS INTEGRALLY LTED FOR THE SHORT CIRCUIT FAULT CURRENT, VOLTAGE, PHASING, BREAKER SIZES, CURRENT RATING, AND OTHER INFORMATION INDICATED ON THE DRAWINGS.

16B 3-2 PANELBOARDS - PANELS LARGER THAN 400 AMPS

PANELBOARDS: SQUARE D TYPE NQDD OR NF, AS APPLICABLE, BASED ON VOLTAGE AND AMPERE RATING AND REQUIRED SHORT-CIRCUIT INTERRUPTING RATINGS AS SCHEDULED ON THE DRAWINGS, OR APPROVED EQUAL BY SIEMENS, CUTLER HAMMER, OR GENERAL ELECTRIC; COMPLETE WITH BOLT-ON THERMAL MAGNETIC, MOLDED CASE CIRCUIT BREAKERS ASSEMBLED IN A DEAD-FRONT FINISHED CABINET CONTAINING A TYPED WRITTEN CARD DIRECTOR INDICATING EXACTLY WHAT EACH CIRCUIT BREAKER CONTROLS; FULLY-RATED AND WITH THE INTEGRATED SHORT CIRCUIT CURRENT RATINGS INDICATED ON THE DRAWINGS. PULL-IN TYPE BREAKERS WILL NOT BE ACCEPTABLE. ALL TWO AND THREE POLE BREAKERS: COMMON TRIP TYPE. BREAKERS USED AS SWITCHES FOR 120V OR 277V LIGHTING CIRCUITS APPROVED FOR THE PURPOSE AND MARKED "SWD". BREAKERS USED FOR THE PROTECTION OF HVAC AND REFRIGERATION EQUIPMENT: HACR TYPE.

16B 3-3 LOADCENTERS - PANELS 255 AMPS AND SMALLER THAN 400 AMPS

LOADCENTERS: SQUARE D, TYPE QO, BASED ON VOLTAGE AND AMPERE RATINGS AND REQUIRED SHORT-CIRCUIT INTERRUPTING RATINGS AS SCHEDULED ON THE DRAWINGS, OR APPROVED EQUAL BY SIEMENS, CUTLER HAMMER, OR GENERAL ELECTRIC. CIRCUIT BREAKERS SHALL BE SQUARE D OR EQUIVALENT TYPE QO (PLUG-ON) THERMAL MAGNETIC TRIP, WITH AN INTEGRAL CROSSBAR TO ENSURE SIMULTANEOUS OPENING OF ALL POLES IN MULTI-POLE CIRCUIT BREAKERS. IN A DEAD-FRONT FINISHED CABINET CONTAINING A TYPED WRITTEN CARD DIRECTORY INDICATING EXACTLY WHAT EACH CIRCUIT BREAKER CONTROLS; FULLY-RATED AND WITH THE INTEGRATED SHORT CIRCUIT CURRENT RATINGS INDICATED ON THE DRAWINGS. BREAKERS USED FOR THE PROTECTION OF HVAC AND REFRIGERATION EQUIPMENT: HACR TYPE.

16B 3-4 DISCONNECT (SAFETY) SWITCHES

DISCONNECT (SAFETY) SWITCHES: SQUARE D, SIEMENS, CUTLER HAMMER, OR GENERAL ELECTRIC FUSED OR NON-FUSED (AS INDICATED ON DRAWINGS OR REQUIRED) NEMA KSI, HEAVY DUTY, EXTERNALLY OPERATED, VISIBLE-BLADE SAFETY SWITCHES; NEMA ENCLOSURE TYPE INDICATED ON THE DRAWINGS OR SUITABLE FOR THE ENVIRONMENT IN WHICH INSTALLED. BASED ON FUSIBLE SWITCH AND FUSE SIZES INDICATED, INCLUDE CLASS R, J, OR L FUSE PROVISIONS AS APPLICABLE.

WHERE INDICATED, PROVIDE FUSIBLE SWITCHES PERMANENTLY LABELED AS SUITABLE FOR USE AS SERVICE ENTRANCE EQUIPMENT, WITH INTEGRAL AND SEPARATE NEUTRAL AND GROUND ASSEMBLIES, SUITABLE FOR THE SIZES OF CONDUCTORS INDICATED. DO NOT DOUBLE-TERMINATE OR TERMINATIONS NOT SPECIFICALLY LISTED AS SUITABLE FOR MORE THAN ONE CONDUCTOR.

PROVIDE SWITCHES WHERE NOT FURNISHED WITH THE STARTING EQUIPMENT, AT ALL OTHER POINTS REQUIRED BY NFPA 70, AND WHERE INDICATED ON THE DRAWINGS.

16B 3-5 FUSES

PROVIDE EACH CIRCUIT AND SET OF FUSE CLIPS THROUGHOUT THE WORK WITH BUSSMANN, FERRAZ SHAWMUT, OR LITTLEFUSE FUSES, SIZES AND TYPES AS REQUIRED OR INDICATED. ALL FUSES LARGER THAN 600A: UL CLASS L, SIMILAR TO TYPE KRP-C BUSSMANN LOW PEAK OR EQUAL. FUSES USED TO PROTECT MOTORS: UL CLASS RK5, BUSSMANN FUSETRON OR EQUAL. FUSES USED TO PROTECT ALL OTHER ELECTRICAL EQUIPMENT: UL CLASS RK1, DUAL ELEMENT, BUSSMANN LPS/LPM OR EQUAL. ALL FUSED DEVICES SHALL BE LABELED AS TO TYPE AND SIZE OF FUSE REQUIRED.

16B PART 4 LIGHT FIXTURES, LAMPS AND BALLASTS

16B 4-1 LIGHT FIXTURE LOCATIONS

LIGHT FIXTURES SHOWN ON THE ELECTRICAL DRAWINGS REPRESENT GENERAL ARRANGEMENTS ONLY. REFER TO ARCHITECTURAL DRAWINGS FOR MORE EXACT LOCATIONS. COORDINATE LOCATION WITH ALL OTHER TRADES BEFORE INSTALLATION TO AVOID CONFLICTS. COORDINATE LIGHT FIXTURE LOCATIONS IN MECHANICAL ROOMS WITH FINAL INSTALLED PIPING AND DUCTWORK LAYOUTS.

16B 4-2 LIGHT FIXTURES

PROVIDE LIGHT FIXTURES AS SCHEDULED ON DRAWINGS, INCLUDING ALL LAMPS, ALL NECESSARY ACCESSORIES, MATERIAL AND LABOR TO SECURELY HANG, CLEAN, AND MAKE LIGHT FIXTURES COMPLETELY READY FOR USE. LIGHT FIXTURE MODEL NUMBERS SCHEDULED ON THE DRAWINGS SHOW ONLY THE MANUFACTURER, GRADE AND STYLE OF LIGHT FIXTURES REQUIRED. PROVIDE ALL HANGERS, SUPPORTS, AND MISCELLANEOUS HARDWARE REQUIRED TO INSTALL LIGHT FIXTURES; PROPER TRIM TO FIT EACH CEILING CONDITION ACTUALLY ENCOUNTERED; ADDITIONAL THE WIRES CONNECTED TO STRUCTURE TO CONFORM TO SEISMIC REQUIREMENTS WHERE REQUIRED BY THE APPLICABLE BUILDING CODE.

PACKAGING OF LIGHT FIXTURES WILL NOT BE ALLOWED. ONLY THOSE LUMINARIES LISTED IN THE LIGHT FIXTURE SCHEDULE, OR APPROVED IN ACCORDANCE WITH SUBSTITUTIONS OF THESE SPECIFICATIONS, WILL BE ACCEPTED. WHERE THE LIGHT FIXTURE SCHEDULE INDICATES AN ALLOWANCE FOR A SPECIFIC LIGHT FIXTURE, THE PRICE IS A CONTRACTOR PRICE. INCLUDE ALL ADDITIONAL COSTS FOR FREIGHT, LAMPS, AND INSTALLATION OF LIGHT FIXTURE AND LAMPS.

SURFACE-MOUNT ALL FLOUORESCENT LIGHT FIXTURES LOCATED IN AREAS WITHOUT SUSPENDED CEILINGS UNLESS OTHERWISE INDICATED ON THE DRAWINGS. PROVIDE RIGID METAL SPACERS FINISHED IN WHITE ENAMEL BETWEEN THE TOP OF EACH LIGHT FIXTURE AND THE CEILING ABOVE TO MAINTAIN A 1-1/2-INCH SPACE. SPACERS SHALL BE APPROVED BEFORE INSTALLATION.

INSTALL FLOUORESCENT LIGHT FIXTURES HUNG IN CONTINUOUS ROWS ON CHANNEL STRUTS SPECIFICALLY DESIGNED FOR THIS PURPOSE.

INSTALL ALL FLOUORESCENT LIGHT FIXTURES LOCATED IN AREAS WITHOUT CEILINGS IMMEDIATELY BELOW THE ROOF-FRAMING MEMBERS, OR SUSPENDED FROM CHAIN HANGERS SUITABLE IN LENGTH TO PROVIDE THE INDICATED MOUNTING HEIGHT. HANGERS: "HYDRE" HANGER TYPE FOR OUTLET BOX MOUNTING, COMPLETE WITH GROUNDING RECEPTACLE, PLUG, 3-WIRE CORD AND NECESSARY CHAIN.

THROUGH WIRING OF RECESSED LIGHT FIXTURES, IN SUSPENDED CEILINGS, IS NOT PERMITTED. CONNECT EACH LIGHT FIXTURE BY A WHIP TO A JUNCTION BOX. THE WHIP SHALL BE OF SUFFICIENT LENGTH TO ALLOW THE LIGHT FIXTURE TO BE RELOCATED WITHIN A 6-FOOT RADIUS.

16B 4-3 LAMPS

PROVIDE LAMPS AS INDICATED ON THE DRAWINGS FOR ALL LIGHT FIXTURES; OR, IF NOT INDICATED, AS RECOMMENDED BY THE LIGHT FIXTURE MANUFACTURER. IN ALL CASES, LAMPS SHALL BE COMPATIBLE WITH THE SPECIFIED LIGHT FIXTURE. ACCEPTABLE LAMP MANUFACTURERS: GENERAL ELECTRIC, OSRAM/SYLVANIA, PHILIPS, OR VENTURE.

ALL FLOUORESCENT LAMPS SHALL BE MINIMUM OF 3500 DEGREES K, WITH A MINIMUM COLOR-RENDERING INDEX OF 70, UNLESS NOTED OR DIRECTED OTHERWISE. ALL FLOUORESCENT LAMPS IN SALES AREAS SHALL BE 3000 DEGREES K WITH A COLOR-RENDERING INDEX OF 80. ALL METAL HALIDE LAMPS IN SALES AREAS SHALL BE COATED, 3000 DEGREES K WITH A COLOR-RENDERING INDEX OF 70.

INCANDESCENT LAMPS: TYPE AND WATTAGE AS SHOWN ON THE DRAWINGS; RATED 130V UNLESS OTHERWISE SCHEDULED OR SPECIFIED.

16B 4-4 BALLASTS

FLOUORESCENT BALLASTS: LOW HEAT TYPE, THERMALLY PROTECTED AGAINST OVERHEATING; ETL-CBM, CLASS P TO MEET ALL REQUIREMENTS OF SECTION 410-73 (E) OF THE NFPA 70 AS A MINIMUM; COMPLY WITH THE NATIONAL BALLAST ENERGY LAW; 90- PERCENT POWER FACTOR OR GREATER; SOUND LEVELS NOT EXCEEDING CLASS A AMBIENT NOISE LEVELS.

INDOOR FLOUORESCENT BALLASTS: ELECTRONIC TYPE SUITABLE FOR OPERATION OF TB LAMPS; TOTAL HARMONIC DISTORTION LESS THAN 20 PERCENT; FREQUENCY OF OPERATION OF 20 KHZ OR GREATER WITH NO VISIBLE FLICKER; LINE TRANSIENT WITHSTAND RATINGS AS DEFINED IN ANSI/IEEE C82.41, CATEGORY A; MANUFACTURERS: ADVANCE REL/VEL SERIES OR APPROVED EQUAL BY MAGNETEK, MOTOROLA, OR OSRAM.

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