SECTION 16B BASIC ELECTRICAL MATERIALS AND METHODS:

16B METHODS

16B RACEWAYS

METALLIC CONDUIT AND TUBING:

ELECTRICAL METALLIC TUBING, COUPLINGS AND FITTINGS (EMT): ANSI C80.3, UL 797. ONLY STEEL PRODUCTS ALLOWED.
REDUCED WALL EMT IS NOT ALLOWED

FLEXIBLE METAL CONDUIT (FMC): ZINC-COATED STEEL OR ALUMINUM, UL 1.
REDUCED-WALL FMC IS NOT ALLOWED

INTERMEDIATE METAL CONDUIT (IMC): HOT-DIP GALVANIZED RIGID STEEL CONDUIT: ANSI C80.6, UL 1242.

LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC): FLEXIBLE STEEL CONDUIT WITH PVC JACKET: UL 360

RIGID METAL CONDUIT (RMC): HOT-DIP GALVANIZED RIGID STEEL CONDUIT (GRS): ANSI C80.1, UL 6.

PLASTIC-COATED IMC, RMC, AND FITTINGS: NEMA RN 1, UL LISTED.

IMC AND RMC FITTINGS: NEMA FB 1; COMPATIBLE WITH CONDUIT TYPE AND MATERIAL, UL LISTED

NON-METALLIC CONDUIT AND TUBING:

RIGID NONMETALLIC CONDUIT (RNC): SCHEDULE 40 PVC, 90 DEG C RATED, NEMA TC-2, UL 651; FITTINGS: NEMA TC 3, TC 6; UL 514, COMPATIBLE WITH CONDUIT/TUBING TYPE AND MATERIAL, UL LISTED.

16B RACEWAY INSTALLATION

ABOVE GROUND USE
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 EXPOSED TO WEATHER, OR EXPOSED TO OTHER HAZARDOUS CONDITIONS.

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.

UNDERGROUND USE
PROVIDE GRS INSTALLED BELOW GRADE WITH A CORROSION RESISTANT BONDED-PLASTIC OR APPROVED MASTIC COATING. THIS SHALL INCLUDE THE 90-DEGREE ELBOW BELOW GRADE AND THE ENTIRE VERTICAL TRANSITION TO ABOVE GRADE.

RNC 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.

EQUIPMENT CONNECTIONS
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, AND TO CONNECT TO KITCHEN AND FOOD SERVICE EQUIPMENT. 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.

GENERAL RACEWAY INSTALLATION REQUIREMENTS
INSTALL RACEWAYS PARALLEL AND PERPENDICULAR TO BUILDING LINES.

INSTALL RACEWAYS TO REQUIREMENTS OF STRUCTURE AND TO REQUIREMENTS OF ALL OTHER WORK ON THE PROJECT; 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. RADII OF BENDS SHALL BE AS LONG AS POSSIBLE AND NEVER SHORTER THAN THE CORRESPONDING TRADE ELBOW.

USE LONG RADIUS ELBOWS FOR ALL UNDERGROUND INSTALLATIONS, WHERE NECESSARY OR INDICATED.

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. HOMERUNS CONTAINING MORE THAN ONE BRANCH CIRCUIT SHALL NOT BE LESS THAN 3/4- INCH IN SIZE.

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. ALSO WHEN USING RNC OR RAC IN EXPOSED ENVIRONMENTS IN ACCORDANCE WITH THE NEC AND EXPANSION/CONTRACTION PROPERTIES OF RNC OR RAC.

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.

16B 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 CONDUCTORS AND CABLES

CONDUCTOR MATERIAL:

ANNEALED (SOFT) COPPER COMPLYING WITH ICEA S-95-658/NEMA WC70;

CONDUCTOR INSULATION TYPES: 90-DEGREE C RATED, TYPE THHN/THWN-2 OR XHHW-2 COMPLYING WITH ICEA S-95-658/NEMA WC70.

SIZES OF CONDUCTORS AND CABLES INDICATED OR SPECIFIED ARE IN AMERICAN WIRE GAGE (AWG - BROWN AND SHARPE).

ALL FEEDER AND BRANCH CIRCUIT CONDUCTORS NO. 8 AWG AND LARGER: STRANDED.

ALL CONDUCTORS, NO. 10 AWG AND SMALLER: SOLID COPPER

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.

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.

FLEXIBLE CORDS AND CABLES: STRANDED COPPER CONDUCTORS FOR ALL, UNLESS NOTED OTHERWISE.

SPECIAL PURPOSE CONDUCTORS AND CABLES, SUCH AS LOW VOLTAGE CONTROL AND SHIELDED INSTRUMENT WIRING: UNLESS INDICATED OTHERWISE, SHALL BE AS RECOMMENDED BY THE SYSTEM EQUIPMENT MANUFACTURER.

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 INSTALLATION OF CONDUCTORS AND CABLES

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

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.

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.

THE NUMBER OF CONDUCTORS IN A SPECIFIC RACEWAY "HOME RUN" IS INDICATED WITH CROSS LINES (TICK MARKS) ON EACH "CIRCUIT RUN" ON THE DRAWINGS.

COMMON OR SHARED NEUTRALS ARE NOT ALLOWED UNLESS SHOWN ON THE DRAWINGS TO BE USED OR SPECIFICALLY NOTED TO BE ALLOWED.

WHERE MULTI-WIRE BRANCH CIRCUITS (I.E., SHARED NEUTRAL) ARE ALLOWED, THEY SHALL BE PROVIDED WITH A MEANS THAT WILL SIMULTANEOUSLY DISCONNECT ALL UNGROUNDED CONDUCTORS AT THE POINT THE BRANCH CIRCUIT ORIGINATES. MULTI-POLE BREAKERS OR 3 SINGLE POLE BREAKERS WITH A HANDLE TIE ARE TWO EXAMPLES.

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:

NORMAL OR NON-ESSENTIAL CIRCUITS.

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.

THE MINIMUM WIRE SIZE FOR ALL CONDUCTORS IN THIS RACEWAY: NO. 10 AWG.

ONLY 15A AND 20A BRANCH CIRCUIT HOMERUNS MAY BE COMBINED INTO ONE RACEWAY.

GFCI CIRCUITS.

DO NOT USE MULTI-CONDUCTOR CIRCUITS, WITH A SHARED NEUTRAL, FOR ANY GFCI CIRCUIT BREAKER OR RECEPTACLE CIRCUIT.

EMERGENCY POWER CIRCUITS - INCLUDES ALL CIRCUITS COVERED UNDER ARTICLES 700, 701 AND 702.

MAXIMUM OF EIGHT CONDUCTORS IN A SINGLE RACEWAY.
MINIMUM RACEWAY SIZE: 3/4-INCH.
DO NOT INSTALL ANY OTHER TYPE OF CIRCUIT IN THIS RACEWAY.

ONLY 15A AND 20A BRANCH CIRCUIT HOMERUNS MAY BE COMBINED INTO ONE RACEWAY.

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.

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 FEEDERS AND BRANCH CIRCUITS, SIZED IN ACCORDANCE WITH NFPA 70 TABLES 250.66 OR 250.122, AS APPLICABLE, UNLESS INDICATED AS LARGER ON THE DRAWINGS.

WIRING SHALL HAVE INSULATION OF THE PROPER COLOR TO MATCH COLOR CODE SYSTEM IN THE TABLE BELOW UNLESS THERE IS A COLOR SYSTEM CURRENTLY IN USE BY THE FACILITY, IN WHICH CASE THE COLORS ARE TO MATCH THE EXISTING SYSTEM. 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.

SYSTEM VOLTAGE

240V AND UNDER, INCLUDES - 208Y/120, 120/240, 120/208, 240D/120 SYSTEMS
PHASE A - BLACK
PHASE B - RED
PHASE C - BLUE
NEUTRAL - WHITE
EQUIPMENT GROUND GREEN
ISOLATED GROUND - GREEN W/YELLOW STRIPE.

480V AND 480Y/277V

PHASE A - BROWN
PHASE B - ORANGE
PHASE C - YELLOW
NEUTRAL - GRAY
EQUIPMENT GROUND - GREEN.

USE OF 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.

FOR VERTICAL DROPS IN STUD WALLS.

IN LIEU OF EMT, ONLY FOR 15A AND 20A BRANCH CIRCUITS (WITH UP TO FOUR (4) CONDUCTORS, NOT INCLUDING GROUND CONDUCTOR), AND ONLY IN DRY CONCEALED LOCATIONS ABOVE GRADE, EXCEPT WHERE SPECIFICALLY NOT PERMITTED BY NFPA 70.

MC CABLE SHALL NOT BE USED FOR ANY USE NOT LISTED ABOVE.
EXAMPLES OF THOSE USES INCLUDE, BUT ARE NOT LIMITED TO:

HOMERUNS TO PANELBOARDS.
WHERE EXPOSED TO VIEW.
WHERE EXPOSED TO DAMAGE.
HAZARDOUS LOCATIONS.
WET LOCATIONS.
WHEN RESTRICTED OTHERWISE.
WHEN SPECIFICALLY DISALLOWED BY THE LOCAL AHJ.
WHEN SPECIFICALLY DISALLOWED BY THE LANDLORD.
CIRCUITS THAT CAN BE SUPPLIED BY AN EMERGENCY OR STANDBY POWER SOURCE.

16B 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.

JUNCTION BOXES INSTALLED BEHIND WALL CASES, AND IN OR ON OTHER STORE FIXTURES, EXCEPT WHERE OTHERWISE SPECIFIED, SHALL BE 4-INCH SQUARE OR LARGER, WITH GALVANIZED COVERS.

HORIZONTALLY MOUNT JUNCTION BOXES UNDER CENTER FIXTURES (AND CASES), HANDY BOXES OR 4-INCH SQUARE BOXES WITH TOPS OF BOXES NOT MORE THAN 3-1/2 INCHES ABOVE THE FLOOR. SIZE JUNCTION BOXES TO ADEQUATELY CONTAIN ALL REQUIRED CONDUCTORS AND SPLICES.

16B OUTLET BOXES

ALL OUTLETS INCLUDING LIGHT FIXTURE, SWITCH, RECEPTACLE, AND SIMILAR OUTLETS: NATIONAL ELECTRICAL, APPLETON, 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 WEATHERPROOF COVERS, IN ALL AREAS SUBJECT TO DAMP, WET, OR HARSH CONDITIONS.

16B 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 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:

VERTICALLY ALIGNED WITH THE GROUND SLOT MOUNTED AT THE TOP: 16 INCHES ABOVE FINISHED FLOOR.

HORIZONTALLY ALIGNED, WITH NEUTRAL SLOT MOUNTED AT THE TOP: 16 INCHES ABOVE FINISHED FLOOR.

FOR 36-INCH HIGH COUNTER TOPS: 44 INCHES ABOVE FINISHED FLOOR, VERTICALLY ALIGNED.

FOR 34-INCH HIGH COUNTER TOPS: 40 INCHES ABOVE FINISHED FLOOR, VERTICALLY ALIGNED.

MECHANICAL AND ELECTRICAL EQUIPMENT ROOMS AND JANITORS CLOSETS: 44 INCHES ABOVE FINISHED FLOOR, VERTICALLY ALIGNED.

GARAGES: 24 INCHES ABOVE FINISHED FLOOR, VERTICALLY ALIGNED.

WEATHERPROOF EXTERIOR RECEPTACLES: 24 INCHES ABOVE FINISHED GRADE, VERTICALLY ALIGNED.

GFCI RECEPTACLES: SAME AS GENERAL RECEPTACLES.

ISOLATED GROUND RECEPTACLES: SAME AS GENERAL RECEPTACLES.

SPD RECEPTACLES: SAME AS GENERAL RECEPTACLES.

CLOCK RECEPTACLES: 84 INCHES ABOVE FINISHED FLOOR.

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:

GENERAL: 46 INCHES ABOVE FINISHED FLOOR.

ABOVE COUNTERS: SAME AS FOR RECEPTACLES.

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).

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

MULTI-OUTLET ASSEMBLIES:

16 INCHES ABOVE FINISHED FLOOR.

TELEPHONE/DATA OUTLET BOXES:

GENERAL: MATCH MOUNTING HEIGHT OF ADJACENT WIRING DEVICE LISTED ABOVE.

WALL-MOUNTED TELEPHONE: 40 INCHES ABOVE FINISHED FLOOR.

FOR OTHER THAN WIRING DEVICES, REFER TO PARAGRAPHS, ARTICLES, SECTIONS, DIVISIONS, OR DRAWINGS TO OBTAIN MOUNTING HEIGHTS FOR SPECIFIC EQUIPMENT OR SYSTEMS.

16B WIRING DEVICES

THE CATALOG NUMBERS LISTED FOR WIRING DEVICES ARE GENERALLY FOR 20A RATED DEVICES. WHERE 15A RATED DEVICES ARE INDICATED ON THE DRAWINGS OR REQUIRED FOR CIRCUIT RATING LIMITATIONS, PROVIDE WIRING DEVICES EQUIVALENT TO THOSE SPECIFIED FOR 20A BUT RATED FOR 15A.

ALL RECEPTACLES LOCATED OUTDOORS OR IN DAMP OR WET LOCATIONS: SHALL BE LISTED AS ?WEATHER RESISTANT? DESIGNATED BY A ?WR? ON THE FACEPLATE.

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: REFER TO DETAIL SHOWING RECEPTACLES TABLE.

Type of Device	Hubbell	Leviton
Simplex Receptacle	HBL 5361	5261
Duplex Receptacle	BR20	CR20
GFCI Receptacle	GF20LA	7899-H
WR/GFCI Receptacle	GFTR20	W7899-T
Safety Receptacle (20A / 125V)	HBL8300SGA	8300-SGG
Isolated Ground (IG) Receptacle	IG5352	5362-IG
Single Pole Switch	DS120	CSB1-20
Double Pole Switch	DS220	CSB2-20
Three-way Switch	DS230	CSB3-20

EMERGENCY SHUNT RELAY OR AUTOMATIC LOAD CONTROL RELAY: UL LISTED TO STANDARD 924 AS EMERGENCY LIGHTING AND POWER EQUIPMENT. CONNECT EMERGENCY SHUNT RELAY IN PARALLEL WITH A WALL SWITCH. LOSS OF NORMAL POWER SHALL CAUSE RELAY TO AUTOMATICALLY SHUNT EMERGENCY POWER TO LIGHTING CIRCUIT REGARDLESS OF WALL SWITCH POSITION. EMERGENCY LIGHTING CIRCUIT SHALL CONTINUE TO OPERATE AT FULL POWER UNTIL NORMAL POWER HAS BEEN RESTORED. PROVIDE A TWO-GANG JUNCTION BOX WITH SEPARATION BARRIER AND PLASTER RING FOR THE EMERGENCY SHUNT RELAY, AND INSTALL IT ADJACENT TO ITS ASSOCIATED LIGHT SWITCH. PROVIDE LIGHTING CONTROLS AND DESIGN MODEL GR2001 E/S, EMERGENCY SHUNT RELAY, OR EQUIVALENT BY BODINE .

16B SWITCH AND OUTLET COVER PLATES

SWITCH AND OUTLET PLATES: COLORED, 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: STAMPED STEEL, CADMIUM PLATED. INSTALL GROUPS OF SWITCHES UNDER ONE GANGED-PLATE, USUALLY HORIZONTALLY; OR, WHERE REQUIRED BY DETAILS, VERTICALLY. SET ALL COVER PLATES PLUMB, PARALLEL, AND FINISHED FLUSH WITH THE WALL.

16B WEATHERPROOF COVER PLATES

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

FOR EXTERIOR UNATTENDED, WET LOCATIONS OR OTHER LOCATIONS AS INDICATED: IN-USE NEMA 3R RECESSED OR FLUSH MOUNT, 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. BACK BOX MUST BE SUITABLE FOR CONDUIT CONNECTING. COORDINATE BACK BOX WITH WALL DEPTH. INTERMATIC WP1000RC/HRC OR EQUAL.

FOR ATTENDED WET OR DAMP LOCATIONS: WEATHERPROOF COVER PLATES, UL-LISTED FOR WET LOCATIONS WITH COVER(S) CLOSED; DIE-CAST ALUMINUM OR TYPE 302 STAINLESS STEEL; SINGLE-COVER FOR SWITCHES AND VERTICALLY MOUNTED RECEPTACLES; DOUBLE-COVER FOR HORIZONTALLY MOUNTED RECEPTACLES; SELF-CLOSING COVERS.

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 ELECTRICAL SERVICE AND GROUNDING

16B ELECTRICAL SERVICE

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

PROVIDE, OR ARRANGE WITH THE SERVING UTILITY FOR INSTALLATION TO PROVIDE, A RECORDING VOLTMETER AT THE SERVICE POINT, ON THE FIRST DAY THE FACILITY IS OPEN FOR BUSINESS, FOR A 24-HOUR VOLTAGE TEST. IF VOLTAGE AND REGULATION 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 VOLTMETER CHART.

16B 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 THE REQUIREMENTS OF ALL 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 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 DISTRIBUTION AND CONTROL EQUIPMENT

16B LIGHTING AND APPLIANCE PANELBOARDS

PANELBOARDS: SQUARE D TYPE NQOD OR NF, AS APPLICABLE, 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; COMPLETE WITH BOLT-ON THERMAL MAGNETIC, MOLDED CASE CIRCUIT BREAKERS ASSEMBLED IN A DEAD-FRONT FINISHED CABINET CONTAINING A TYPEWRITTEN CARD DIRECTORY INDICATING EXACTLY WHAT EACH CIRCUIT BREAKER CONTROLS; FULLY-RATED AND WITH THE INTEGRATED SHORT CIRCUIT CURRENT RATINGS INDICATED ON THE DRAWINGS. PLUG-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 CIRCUIT BREAKERS IN EXISTING PANELBOARDS

PROVIDE NEW CIRCUIT BREAKERS, FOR INSTALLATION IN EXISTING PANELBOARDS, OF THE SAME MANUFACTURER, TYPE AND SHORT CIRCUIT CURRENT INTERRUPTING RATINGS AS THE EXISTING PANELBOARD CIRCUIT BREAKERS.

16B 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/LPN OR EQUAL. ALL FUSED DEVICES SHALL BE LABELED AS TO TYPE AND SIZE OF FUSE REQUIRED.

FURNISH THREE SPARE FUSES OF EACH SIZE AND TYPE USED ON THE PROJECT (EXCEPT FOR MAIN SWITCH FUSES, FURNISH ONE SPARE), NEATLY CONTAINED IN A PROPERLY LABELED CABINET.

16B DRY-TYPE TRANSFORMERS

TRANSFORMERS: GENERAL PURPOSE, UL-LISTED/LABELED. COMPLY WITH NEMA ST-020 STANDARDS.

INSULATION CLASS: FOR THREE PHASE TRANSFORMERS LESS THAN 15 KVA AND ALL SINGLE PHASE ? 185 DEGREES C, UL-COMPONENT-RECOGNIZED INSULATION SYSTEM WITH A MAXIMUM OF 115 DEGREE C RISE ABOVE A 40 DEGREE C AMBIENT TEMPERATURE; FOR THREE PHASE TRANSFORMERS 15 KVA AND LARGER - 220 DEGREES C, UL-COMPONENT-RECOGNIZED INSULATION SYSTEM WITH A MAXIMUM OF 150 DEGREE C RISE ABOVE A 40 DEGREE C AMBIENT TEMPERATURE. UL-COMPONENT-RECOGNIZED INSULATION SYSTEM REPLACES THE UL1446 INSULATION RATING SYSTEM THAT USED LETTERS.

PHASES, VOLTAGES, AND SIZES: AS INDICATED ON THE DRAWINGS.

SOUND LEVEL: NOT EXCEEDING 3 dBA LESS THAN NEMA STANDARDS FOR THE SIZES INDICATED.

FULL-CAPACITY PRIMARY TAPS: BELOW 25 KVA ?ONE 5 PERCENT TAP ABOVE AND ONE 5 PERCENT TAP BELOW; 25 KVA TO 500 KVA - SIX 2.5 PERCENT TAPS (2 ABOVE, 4 BELOW); ABOVE 500 KVA - FOUR 2.5 PERCENT (2 ABOVE, 2 BELOW).

TRANSFORMER CORE AND COIL ASSEMBLIES: MOUNTED ON INTEGRAL VIBRATION-ABSORBING PADS.

TRANSFORMERS 75 KVA AND LARGER SHALL BE FLOOR MOUNTED UNLESS INDICATED OTHERWISE. TRANSFORMERS 45 KVA AND SMALLER MAY BE WALL MOUNTED WHERE WALL CONSTRUCTION IS SUITABLE FOR THE LOAD. FLOOR MOUNTED TRANSFORMERS SHALL BE SECURELY BOLTED TO A 4 INCH HOUSE KEEPING PAD WITH VIBRATION ISOLATION PADS. WALL MOUNTED OR SUSPENDED TRANSFORMERS SHALL HAVE A MEANS OF ISOLATING VIBRATION FROM THE SUPPORT.

TRANSFORMERS UP THROUGH 1000 KVA SHALL BE MOUNTED ON ELASTOMERIC VIBRATION ISOLATION PADS. PAD SHALL BE CONSTRUCTED OF NEOPRENE, RUBBER, GLASS FIBER, OR A COMBINATION THEREOF. PADS SHALL BE ?RIBBED? OR ?WAFFLED? IN TEXTURE. PADS SHALL BE SELECTED FOR SMALLEST DUROMETER (HARDNESS), PREFERABLY LESS THAN 50. DEFLECTION OF PAD SHALL BE .25? STATIC MINIMUM. STACK PADS UNTIL THE DESIRED DEFLECTION IS ACHIEVED.

MAKE FINAL CONDUIT CONNECTIONS TO TRANSFORMERS WITH FLEXIBLE CONDUIT, WITH AT LEAST 6 INCHES OF SLACK IN ALL DIRECTIONS.

TRANSFORMER ENCLOSURES: FULLY ENCLOSED (EXCEPT FOR VENTILATION OPENINGS), NEMA 2, DRIP-PROOF, FABRICATED OF HEAVY GAUGE SHEET STEEL CONSTRUCTION

PROVIDE ENERGY-EFFICIENT TRANSFORMERS COMPLYING WITH NEMA TP-1, WHEN TESTED IN ACCORDANCE WITH NEMA TP-2.

K-RATED TRANSFORMERS SHALL BE PROVIDED AS INDICATED ON THE DRAWINGS AND BE LISTED FOR 115 DEGREE C RISE.

MANUFACTURERS: SQUARE D, CUTLER HAMMER, GENERAL ELECTRIC, HAMMOND, ACME OR SIEMENS

16B FRACTIONAL HORSEPOWER MANUAL MOTOR STARTERS

FRACTIONAL HORSEPOWER MANUAL MOTOR STARTERS SHALL BE:

SQUARE D CLASS 2510, TYPE F
GENERAL ELECTRIC CR101
SIEMENS MSF SERIES
WESTINGHOUSE MST SERIES
CUTLER HAMMER 9101 SERIES

MANUAL MOTOR STARTERS FOR FRACTIONAL HORSEPOWER SINGLE PHASE MOTORS SHALL CONSIST OF A MANUALLY OPERATED TOGGLE SWITCH EQUIPPED WITH MELTING ALLOY TYPE OVERLOAD RELAY. THERMAL UNIT SHALL BE OF ONE PIECE CONSTRUCTION AND INTERCHANGEABLE. STARTER SHALL BE INOPERATIVE IF THERMAL UNIT IS REMOVED. PROVIDE FLUSH MOUNTED UNITS IN FINISHED AREAS AND SURFACE MOUNTED UNITS IN UNFINISHED AREAS. STARTERS SHALL HAVE NEMA I GENERAL PURPOSE ENCLOSURE, UNLESS OTHERWISE INDICATED, AND BE RATED FOR THE MOTOR HORSEPOWER REQUIRED.

PROVIDE MANUAL MOTOR STARTERS WITH AN INTEGRAL PILOT LIGHT.

16B MOTOR STARTING SWITCHES

MOTOR STARTING SWITCHES SHALL BE:

SQUARE D CLASS 2510, TYPE K
GENERAL ELECTRIC TC2000 SERIES
SIEMENS MS SERIES
WESTINGHOUSE MST SERIES
CUTLER HAMMER 9115 SERIES

MOTOR STARTING SWITCHES SHALL CONSIST OF A TOGGLE OPERATED TWO OR THREE POLE SWITCH. CONTACTS SHALL BE DOUBLE BREAK SILVER ALLOY, VISIBLE FROM BOTH SIDES OF THE SWITCH AND SHALL HAVE A DIRECT LINKAGE TO THE OPERATOR FOR POSITIVE BREAK. PROVIDE FLUSH MOUNTED UNITS IN FINISHED AREAS AND SURFACE MOUNTED UNITS IN UNFINISHED AREAS. STARTERS SHALL HAVE NEMA I GENERAL PURPOSE ENCLOSURE, UNLESS OTHERWISE INDICATED, AND BE RATED FOR THE MOTOR HORSEPOWER REQUIRED.

PROVIDE HANDLE GUARD WITH LOCKING PROVISIONS.

16B LIGHT FIXTURES, LAMPS AND BALLASTS

16B 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 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 TIE 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 LUMINARES 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 AND INCLUDES ALL ADDITIONAL COSTS FOR FREIGHT, LAMPS, AND INSTALLATION OF LIGHT FIXTURE AND LAMPS.

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

SURFACE-MOUNT ALL FLUORESCENT LIGHT FIXTURES LOCATED IN AREAS WITH A CEILING BUT 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 ALL FLUORESCENT 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: "HYDEE" 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. 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.

16B EMERGENCY LIGHTING UNITS AND EXIT SIGNS

DESCRIPTION: SELF-CONTAINED UNITS COMPLYING WITH UL 924.

BATTERY: SEALED, MAINTENANCE-FREE, LEAD-ACID TYPE. THE BATTERIES SHALL BE OF SUITABLE RATING AND CAPACITY TO SUPPLY AND MAINTAIN AT NOT LESS THAN 87 1/ 2 PERCENT OF THE NOMINAL BATTERY VOLTAGE FOR THE TOTAL LAMP LOAD ASSOCIATED WITH THE UNIT FOR A PERIOD OF AT LEAST 1 1/ 2 HOURS, OR THE UNIT EQUIPMENT SHALL SUPPLY AND MAINTAIN NOT LESS THAN 60 PERCENT OF THE INITIAL EMERGENCY ILLUMINATION FOR A PERIOD OF AT LEAST 1 1/ 2 HOURS.

CHARGER: FULLY AUTOMATIC, SOLID-STATE TYPE WITH SEALED TRANSFER RELAY.

OPERATION: RELAY AUTOMATICALLY TURNS LAMP ON WHEN POWER SUPPLY CIRCUIT VOLTAGE DROPS TO 80 PERCENT OF NOMINAL VOLTAGE OR BELOW. LAMP AUTOMATICALLY DISCONNECTS FROM BATTERY WHEN VOLTAGE APPROACHES DEEP-DISCHARGE LEVEL. WHEN NORMAL VOLTAGE IS RESTORED, RELAY DISCONNECTS LAMPS FROM BATTERY, AND BATTERY IS AUTOMATICALLY RECHARGED AND FLOATED ON CHARGER.

TEST PUSH BUTTON: PUSH-TO-TEST TYPE, IN UNIT HOUSING, SIMULATES LOSS OF NORMAL POWER AND DEMONSTRATES UNIT OPERABILITY.

LED INDICATOR LIGHT: INDICATES NORMAL POWER ON. NORMAL GLOW INDICATES TRICKLE CHARGE; BRIGHT GLOW INDICATES CHARGING AT END OF DISCHARGE CYCLE.

WIRE GUARD: HEAVY-CHROME-PLATED WIRE GUARD PROTECTS LAMP HEADS OR FIXTURES.

INTEGRAL SELF-TEST: FACTORY-INSTALLED ELECTRONIC DEVICE AUTOMATICALLY INITIATES CODE-REQUIRED TEST OF UNIT EMERGENCY OPERATION AT REQUIRED INTERVALS. TEST FAILURE IS ANNUNCIATED BY AN INTEGRAL AUDIBLE ALARM AND FLASHING RED LED.

16B 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 FLUORESCENT LAMPS SHALL BE MINIMUM OF 3500 DEGREES K, WITH A MINIMUM COLOR-RENDERING INDEX OF 70, UNLESS NOTED OR DIRECTED OTHERWISE. ALL FLUORESCENT 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 BALLASTS

FLUORESCENT 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. BALLASTS IN INDOOR LOCATIONS SHALL HAVE DISCONNECTING MEANS EITHER INTERNAL OR EXTERNAL TO THE LUMINAIRE.

INDOOR FLUORESCENT BALLASTS: ELECTRONIC TYPE SUITABLE FOR OPERATION OF T8 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 C62.41, CATEGORY A; MANUFACTURERS: ADVANCE REL/VEL SERIES OR APPROVED EQUAL BY MAGNETEK, MOTOROLA, OR OSRAM.

EXTERIOR AND LOW TEMPERATURE FLUORESCENT BALLASTS: SHALL BE ELECTRONIC TYPE SUITABLE FOR OPERATION OF F72T12/HO AND F96T12/HO LAMPS; SHALL HAVE A TOTAL HARMONIC DISTORTION LESS THAN 20 PERCENT; SHALL HAVE A FREQUENCY OF OPERATION OF 20 KHZ OR GREATER AND OPERATE WITH NO VISIBLE FLICKER; SHALL WITHSTAND LINE TRANSIENTS AS DEFINED IN ANSI/IEEE C62.41, CATEGORY A; SHALL HAVE A MINIMUM STARTING TEMPERATURE OF ?20 DEGREES F; AND SHALL BE ADVANCE REL/VEL SERIES OR EQUAL OF MAGNETEK OR MOTOROLA.

EXTERIOR AND LOW TEMPERATURE FLUORESCENT BALLASTS: SHALL BE MAGNETIC TYPE SUITABLE FOR OPERATION OF T12 LAMPS; SHALL HAVE A MINIMUM STARTING TEMPERATURE OF 0 DEGREES F FOR RAPID START LAMPS AND A MINIMUM STARTING TEMPERATURE OF ?20 DEGREES F FOR 800MA AND 1500MA LAMPS; AND SHALL BE ADVANCE REL SERIES OR EQUAL OF MAGNETEK.

COMPACT FLUORESCENT BALLASTS: SHALL BE THERMALLY PROTECTED AGAINST OVERHEATING; SHALL BE CLASS P; SHALL HAVE A MINIMUM 90 PERCENT POWER FACTOR; SOUND LEVELS SHALL NOT EXCEED CLASS A AMBIENT NOISE LEVELS; AND SHALL BE LOW HEAT TYPE. ALL BALLASTS SHALL BE BY ADVANCE. BALLASTS FOR 36W THRU 55W LAMPS SHALL BE MARK V ELECTRONIC TYPE.

HIGH-INTENSITY DISCHARGE (HID) BALLASTS (INCLUDES HIGH PRESSURE SODIUM (HPS) AND METAL HALIDE (MH)): SHALL HAVE A POWER FACTOR GREATER THAN 90 PERCENT; COMPLY WITH UNDERWRITERS LABORATORY (UL) 1029; PROVIDE NORMAL OPERATION AND LIGHT OUTPUT WITH THE INPUT VOLTAGE IS WITHIN ±10 PERCENT OF NOMINAL BALLAST RATING (EXCEPT HPS LAMPS SMALLER THAN 250W WHICH MUST HAVE THE INPUT VOLTAGE WITHIN +5 PERCENT); SHALL HAVE A MINIMUM STARTING TEMPERATURE OF ?20 DEGREES F. PROVIDE ENCAPSULATED AND REMOTE TYPES WHERE INDICATED ON THE DRAWINGS.

EMERGENCY FLUORESCENT BALLASTS: SHALL BE BODINE B50 OR IOTA I-232 FOR FOUR-FOOT FLUORESCENT LAMPS; SHALL BE BODINE B30 OR IOTA I-160 FOR EIGHT-FOOT FLUORESCENT LAMPS; OR AS NOTED ON THE FIXTURE SCHEDULE OR ELSEWHERE ON THE DRAWINGS.

16B MISCELLANEOUS ELECTRICAL

16B WIRING OF MECHANICAL EQUIPMENT

PROVIDE ALL RACEWAYS AND POWER WIRING FOR ALL DIVISION 15 EQUIPMENT REQUIRING ELECTRICAL CONNECTIONS, INCLUDING, BUT NOT LIMITED TO, PUMPS, WATER HEATERS, AND HVAC EQUIPMENT, AND ALL LINE-VOLTAGE CONTROL AND INTERLOCK WIRING NOT PROVIDED UNDER DIVISION 15. CONNECT PER MANUFACTURERS? WIRING DIAGRAMS. COORDINATE WITH DIVISION 15 FOR DISCONNECTS FURNISHED WITH EQUIPMENT, AND PROVIDE ALL DISCONNECT SWITCHES AS REQUIRED. AFTER INSTALLING WIRING, VERIFY THAT EACH MOTOR LOAD HAS THE CORRECT PHASE ROTATION.

VERIFY THE ACTUAL ?MAXIMUM OVERCURRENT PROTECTION? (MOCP) DEVICE RATINGS AND ?MINIMUM CIRCUIT AMPACITY? (MCA) CONDUCTOR SIZING FOR MECHANICAL EQUIPMENT FROM THE EQUIPMENT NAMEPLATE. BASE ELECTRICAL INSTALLATIONS ON ACTUAL REQUIRED AMPERAGES, WHICH MAY VARY SOMEWHAT FROM THE CONDUCTOR AND EQUIPMENT SIZES SHOWN ON THE DRAWINGS. HOWEVER, IN NO CASE, REDUCE THE SIZE OF CONDUCTORS INDICATED ON THE DRAWINGS WITHOUT AUTHORIZATION FROM THE ENGINEER. PROVIDE PROPERLY SIZED ELECTRICAL WIRING AND EQUIPMENT WITHOUT EXTRA COST TO THE OWNER. NOTIFY THE ENGINEER OF ALL CHANGES REQUIRED IN THE ELECTRICAL INSTALLATION DUE TO EQUIPMENT VARIANCES SO THAT THE EFFECTS ON FEEDERS, BRANCH CIRCUITS, PANELBOARDS, FUSES AND CIRCUIT BREAKERS CAN BE CHECKED PRIOR TO PURCHASING AND INSTALLATION. BE RESPONSIBLE FOR COORDINATING WITH DIVISION 15 TO VERIFY THE ACTUAL AMPACITIES AND CORRECT SIZES OF ALL CONDUCTORS AND OVERCURRENT PROTECTIVE DEVICES FOR ALL EQUIPMENT, AND CORRECT OVERLOAD HEATERS FOR ALL MOTORS, WHEN STARTERS ARE PROVIDED UNDER DIVISION 16.

16B WIRING OF THERMOSTATS, TIME AND TEMPERATURE CONTROLS

PROVIDE ALL RACEWAYS, POWER WIRING, AND LINE-VOLTAGE CONTROL AND INTERLOCK WIRING NOT PROVIDED UNDER DIVISION 15, FOR ALL THERMOSTATS, TEMPERATURE CONTROL DEVICES, AND CONTROLS, INCLUDING, BUT NOT LIMITED TO, AQUASTATS, WATER HEATER INTERLOCKS, TIME SWITCHES AND OVERRIDE TIMERS. SEE MECHANICAL DRAWINGS FOR LOCATIONS AND TEMPERATURE CONTROL DIAGRAMS. LOW-VOLTAGE CONDUCTORS FOR THERMOSTATS AND TEMPERATURE CONTROL SYSTEM MAY BE RUN EXPOSED ABOVE FINISHED ACCESSIBLE CEILINGS, IF APPROVED AND LISTED FOR THIS PURPOSE, BUT SHALL BE INSTALLED IN CONDUIT WITHIN WALLS AND WHERE EXPOSED IN THE WORK AREAS.

16B TELEPHONE SYSTEM PROVISIONS

PROVIDE INCOMING TELEPHONE SERVICE RACEWAYS AS INDICATED ON DRAWINGS OR AS REQUIRED BY THE SERVING TELEPHONE COMPANY. PROVIDE 3/4-INCH THICK PLYWOOD BOARD, FIRE-RETARDANT-TREATED AND STAMPED FRT, SECURELY ANCHORED TO THE WALL, AT THE LOCATION AND OF THE SIZE AS INDICATED ON THE DRAWINGS. PROVIDE FLUSH MOUNTED TELEPHONE OUTLET BOXES WITH 1-INCH EMT STUB-UP CONCEALED TO ACCESSIBLE CEILING SPACE AT LOCATIONS AS INDICATED ON THE DRAWINGS.

16B DATA SYSTEM PROVISIONS

PROVIDE FLUSH MOUNTED DATA OUTLET BOXES WITH 1-INCH CONDUIT STUB-UP CONCEALED TO ACCESSIBLE CEILING SPACE AT LOCATIONS AS INDICATED ON THE DRAWINGS.

16B TIME SWITCHES

TIME SWITCHES: MECHANICAL ASTRONOMICAL, TYPE AS INDICATED, WITH MANUAL BYPASS SWITCH, NEMA ENCLOSURE SUITABLE FOR THE ENVIRONMENT INSTALLED; NUMBER AND TYPES OF CONTACTS, SEQUENCE, AND VOLTAGE AS INDICATED ON THE DRAWINGS, OR AS REQUIRED, BASED ON THE TIME SWITCH FUNCTION AND THE NUMBER OF BRANCH CIRCUITS OR CONTACTORS CONTROLLED. PROVIDE WIRING TO PHOTOCELLS, CONTACTORS, RELAYS OR OTHER CONTROL POINTS AS REQUIRED. MANUFACTURERS: INTERMATIC, PARAGON OR TORK.

16B LIGHTING CONTACTORS

INDUSTRIAL DUTY TYPE; SILVER ALLOY, DOUBLE BREAK CONTACTS, CONVERTIBLE WITH NO AND NC INDICATORS; CAPABLE OF ADDING POLES IN THE FIELD; NUMBER AND RATING OF POLES AS INDICATED ON THE DRAWINGS OR REQUIRED BY THE LOAD CONTROLLED; TYPED DIRECTORY AFFIXED TO THE INSIDE OF THE ENCLOSURE DOOR LISTING ALL BRANCH CIRCUITS SWITCHED AND THE CONTROL POWER BRANCH CIRCUIT.

SHORT CIRCUIT CURRENT RATING:

22,000A AT 240V MAXIMUM

ENCLOSURES: NEMA 1

COIL VOLTAGE: 120V AC

MECHANICALLY-HELD TYPE, CONTROL INTERFACE SHALL BE 2-WIRE INPUT MODULE WITH 3-WIRE OUTPUT;SQUARE D CLASS 8903 LX OR EQUIVALENT OF GENERAL ELECTRIC, SIEMENS, CUTLER HAMMER OR ASCO.

ACCESSORIES:

HAND-OFF-AUTO (HOA) SELECTOR SWITCH

16B MISCELLANEOUS EQUIPMENT AND CONNECTIONS

ALL WIRING AND CONNECTIONS TO ILLUMINATED CASES.

ALL RACEWAYS, AND ALL WIRING AND CONNECTIONS OF DEVICES TO ENERGY MANAGEMENT SYSTEM THAT ARE NOT THE RESPONSIBILITY OF DIVISION 15.

ALL WIRING AND CONNECTIONS OF EXIT DOOR ALARMS.

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SHEET AUTHOR
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SHEET:
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