

SECTION 16B BASIC ELECTRICAL MATERIALS AND METHODS:

16B 1 METHODS

16B 1-1 RACEWAYS

METALLIC CONDUIT AND TUBING:

- 1. ELECTRICAL METALLIC TUBING AND FITTINGS (EMT): ANSI C80.3, UL 797.
2. FLEXIBLE METAL CONDUIT (FMC): ZINC-COATED STEEL OR ALUMINUM, UL 1.
3. INTERMEDIATE METAL CONDUIT (IMC): HOT-DIP GALVANIZED RIGID STEEL CONDUIT: ANSI C80.6, UL 1242.
4. LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC): FLEXIBLE STEEL CONDUIT WITH PVC JACKET: UL 380
5. RIGID METAL CONDUIT (RMC): HOT-DIP GALVANIZED RIGID STEEL CONDUIT (GRS): ANSI C80.1, UL 6.
6. PLASTIC-COATED IMC, RMC, AND FITTINGS: NEMA RN 1, UL LISTED.
7. IMC AND RMC FITTINGS: NEMA FB 1; COMPATIBLE WITH CONDUIT TYPE AND MATERIAL, UL LISTED

NON-METALLIC CONDUIT AND TUBING:

- 1. 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.
2. ENT AND LFMC FITTINGS: COMPATIBLE WITH CONDUIT/TUBING TYPE AND MATERIAL, UL LISTED.

16B 1-2 RACEWAY INSTALLATION

INSTALL ALL CIRCULAR RACEWAYS CONCEALED ABOVE SUSPENDED CEILING 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 BONDED-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 ENT 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, AND TO CONNECT TO KITCHEN AND FOOD SERVICE EQUIPMENT. PROVIDE ALL FMC AND LFMC WITH AN INSULATED BONDING CONDUCTOR.

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 RACEWAYS TO CLEAR ALL OPENINGS, DEPRESSIONS, PIPES, DUCTS, REINFORCING STEEL, AND OTHER UNWANTED 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 IN OR BELOW GRANULAR FILL BELOW SLAB-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 FLANKING GALVANIZING OR ENAMEL. RADIUS 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 SPACERS WITH MALLEABLE SPLT 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 CONDUCTOR 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 PLUMBING 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 BURED 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. CONDUITS 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 WHERE THEIR CONNECTION IS SUBJECT TO VIBRATION OR MOISTURE, WHEN REQUIRED BY NFPA 70, OR BOTH.

16B 1-4 CONDUCTORS AND CABLES

CONDUCTOR MATERIAL:

- 1. ANNEALED (SOFT) COPPER COMPLYING WITH IEC 60364-5-52/IEC 60364-5-53/IEC 60364-5-54/IEC 60364-5-55/IEC 60364-5-56/IEC 60364-5-57/IEC 60364-5-58/IEC 60364-5-59/IEC 60364-5-60/IEC 60364-5-61/IEC 60364-5-62/IEC 60364-5-63/IEC 60364-5-64/IEC 60364-5-65/IEC 60364-5-66/IEC 60364-5-67/IEC 60364-5-68/IEC 60364-5-69/IEC 60364-5-70/IEC 60364-5-71/IEC 60364-5-72/IEC 60364-5-73/IEC 60364-5-74/IEC 60364-5-75/IEC 60364-5-76/IEC 60364-5-77/IEC 60364-5-78/IEC 60364-5-79/IEC 60364-5-80/IEC 60364-5-81/IEC 60364-5-82/IEC 60364-5-83/IEC 60364-5-84/IEC 60364-5-85/IEC 60364-5-86/IEC 60364-5-87/IEC 60364-5-88/IEC 60364-5-89/IEC 60364-5-90/IEC 60364-5-91/IEC 60364-5-92/IEC 60364-5-93/IEC 60364-5-94/IEC 60364-5-95/IEC 60364-5-96/IEC 60364-5-97/IEC 60364-5-98/IEC 60364-5-99/IEC 60364-5-100/IEC 60364-5-101/IEC 60364-5-102/IEC 60364-5-103/IEC 60364-5-104/IEC 60364-5-105/IEC 60364-5-106/IEC 60364-5-107/IEC 60364-5-108/IEC 60364-5-109/IEC 60364-5-110/IEC 60364-5-111/IEC 60364-5-112/IEC 60364-5-113/IEC 60364-5-114/IEC 60364-5-115/IEC 60364-5-116/IEC 60364-5-117/IEC 60364-5-118/IEC 60364-5-119/IEC 60364-5-120/IEC 60364-5-121/IEC 60364-5-122/IEC 60364-5-123/IEC 60364-5-124/IEC 60364-5-125/IEC 60364-5-126/IEC 60364-5-127/IEC 60364-5-128/IEC 60364-5-129/IEC 60364-5-130/IEC 60364-5-131/IEC 60364-5-132/IEC 60364-5-133/IEC 60364-5-134/IEC 60364-5-135/IEC 60364-5-136/IEC 60364-5-137/IEC 60364-5-138/IEC 60364-5-139/IEC 60364-5-140/IEC 60364-5-141/IEC 60364-5-142/IEC 60364-5-143/IEC 60364-5-144/IEC 60364-5-145/IEC 60364-5-146/IEC 60364-5-147/IEC 60364-5-148/IEC 60364-5-149/IEC 60364-5-150/IEC 60364-5-151/IEC 60364-5-152/IEC 60364-5-153/IEC 60364-5-154/IEC 60364-5-155/IEC 60364-5-156/IEC 60364-5-157/IEC 60364-5-158/IEC 60364-5-159/IEC 60364-5-160/IEC 60364-5-161/IEC 60364-5-162/IEC 60364-5-163/IEC 60364-5-164/IEC 60364-5-165/IEC 60364-5-166/IEC 60364-5-167/IEC 60364-5-168/IEC 60364-5-169/IEC 60364-5-170/IEC 60364-5-171/IEC 60364-5-172/IEC 60364-5-173/IEC 60364-5-174/IEC 60364-5-175/IEC 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