SECTION 16051 - BASIC MATERIALS AND METHODS

1.0 GENERAL

1.1 DRAWINGS AND GENERAL PROVISIONS OF CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION-1 SPECIFICATION SECTIONS, APPLY TO THE WORK OF THIS SECTION.

1.2 THIS SECTION IS A DIVISION-16 BASIC MATERIALS AND METHODS SECTION, AND IS PART OF EACH DIVISION-16 SECTION MAKING REFERENCE TO OR REQUIRING PRODUCTS SPECIFIED HEREIN.

1.3 SUBMITTALS: SUBMIT THE PRODUCER'S STANDARD DESCRIPTIVE DATA SHEETS FOR EACH TYPE OF PRODUCT BEING PROVIDED. MARK THE DATA SHEET FOR THE PRODUCT BEING PROVIDED WITH AN IDENTIFYING MARK OR ARROW. THE FOLLOWING SHALL BE SUBMITTED:

A. CABLE TRAY.
B. CABLE TRAY SHOP DRAWINGS.
C. ALL CONDUIT.
D. ALL CONDUIT FITTINGS.
E. SURFACE METAL RACEWAY.
F. GROUND RODS.
G. GROUND ROD CONNECTIONS.
H. CABINETS.
I. ALL CONDUCTORS.
J. ANY OTHER SPECIAL ITEM BEING SUPPLIED ON THE PROJECT.

2.0 PRODUCTS

2.1 ACCEPTABLE PRODUCERS: ALLIED TUBE AND CONDUIT; APPLETON ELECTRIC; BELDEN CORPORATION; W.H. BRADY CO.; CABLOFIL, CARLON; CROUSE-HINDS CO.; CUTLER-HAMMER; ETP; ELCEN METAL PRODUCTS CO.; GENERAL CABLE CO.; GENERAL ELECTRIC CO.; HOFFMAN ENGINEERING CO.; HARVEY HUBBELL, INC.; MIDLAND-ROSS CORPORATION; OKONITE CO.; 0-Z/GEDNEY; PANDUIT, RACO, INC.; REPUBLIC STEEL CORPORATION; 3M; SOUTHWIRE; SETON NAMEPLATE; SQUARE D CO.; THOMAS AND BETTS; TRIANGLE PWC, INC.; WALKER PARKERSBURG TEXTRON; WIREMOLD CO.

2.2 AS INDICATED, PRODUCTS LISTED HEREIN MAY BE COMMON TO VARIOUS DIVISION 16 SECTIONS FOR THIS PROJECT.

2.3 ALL MATERIALS AND EQUIPMENT SPECIFIED HEREIN SHALL BE UL LISTED OR APPROVED ACCORDING TO THE REQUIREMENTS OF APPLICABLE NEC ARTICLES.

2.4 RACEWAYS:

2.4.1 INTERMEDIATE METAL CONDUIT (FEDERAL SPECIFICATION WWC-581) SHALL BE GALVANIZED STEEL, PROTECTED INSIDE AND OUTSIDE. INSTALLATION SHALL BE IN ACCORDANCE WITH NEC ARTICLE 345.

2.4.2 RIGID METAL CONDUIT (NEC ART. 346) SHALL BE GALVANIZED STEEL, PROTECTED INSIDE AND OUTSIDE.

2.4.3 RIGID NONMETALLIC CONDUIT SHALL BE POLYVINYL CHLORIDE (PVC), SCHEDULE 40 OR SCHEDULE 80, AS INDICATED ON THE DRAWINGS. INSTALLATION SHALL BE IN ACCORDANCE WITH NEC ARTICLE 347.

2.4.4 ELECTRICAL METALLIC TUBING (EMT) SHALL BE STEEL, PROTECTED INSIDE AND OUTSIDE BY A COATING OF APPROVED CORROSION-RESISTANT MATERIAL SUCH AS ZINC OR CADMIUM. (FEDERAL SPECIFICATION WWC-563 AND ANSI C80.3) INSTALLATION SHALL BE IN ACCORDANCE WITH NEC ARTICLE 348.

2.4.5 FLEXIBLE METAL CONDUIT (NEC ART. 350) SHALL BE GALVANIZED STEEL, PROTECTED INSIDE AND OUTSIDE.

2.4.6 LIQUID TIGHT FLEXIBLE METAL CONDUIT (NEC ART. 351) SHALL BE GALVANIZED STEEL, PROTECTED INSIDE AND OUTSIDE WITH AN EXTRUDED OUTER LIQUID TIGHT, NON-METALLIC, SUNLIGHT RESISTANT JACKET. USE WITH STANDARD LIQUID TIGHT FITTINGS.

2.4.7 SURFACE RACEWAYS (NEC ART. 352) SHALL BE WIREMOLD METAL SURFACE RACEWAYS, TWO PIECE, SNAP ON COVER TYPE, RECTANGULAR, RUST RESISTANT UNDERCOAT AND GRAY, BUFF OR BROWN FINISH. STEEL SHALL BE MINIMUM .040 INCHES.

2.4.8 WIREWAYS (NEC ART. 362) SHALL BE SHEET METAL TROUGHS WITH HINGED OR REMOVABLE COVERS, RUST RESISTANT UNDERCOAT AND GRAY FINISH COAT. SIZES SHALL BE AS INDICATED ON THE DRAWINGS OR DETERMINED BY THE CONTRACTOR BASED ON NEC REQUIREMENTS ACCORDING TO THE NUMBER OF CONDUCTORS ENCLOSED. EXTERIOR UNITS SHALL BE WEATHERPROOF. STEEL SHALL BE MINIMUM 14 GAUGE.

2.4.9 DATA TRAYS (COMMUNICATION AND SIGNAL ONLY)

2.4.9.1 DATA TRACK: EXCEPT AS OTHERWISE INDICATED, PROVIDE METAL CABLE TRAYS, OF TYPES, CLASSES AND SIZES INDICATED WITH SPLICE HANGERS AND ALL OTHER NECESSARY ACCESSORIES. PROVIDE CABLE TRAYS WITH ROUNDED EDGES AND SMOOTH SURFACES IN COMPLIANCE WITH APPLICABLE STANDARDS, AND WITH THE FOLLOWING CONSTRUCTION FEATURES:

A. CABLE TRAY SHALL BE CABLOFIL NO. CF 105/450 WITH ALL ACCESORIES AS REQUIRED FOR A COMPLETE AND FUNCTIONAL CABLE TRAY SYSTEM INCLUDING BUT NOT LIMITED TO SUPPORTS, CONDUIT CONNECTORS, ETC. ALL CONDUITS TO CABLE TRAY SHALL BE FASTENED TO CABLE TRAY WITH CABLOFIL CONNECTORS.

B. STRAIGHT SECTIONS SHALL BE SUPPLIED IN 10' OR 12' LENGTHS.

E. CABLE TRAY WIDTHS SHALL BE AS INDICATED ON THE DRAWINGS.

F. SPLICE HANGERS MUST ALSO BE CAPABLE OF ACTING AS THE SUPPORT POINTS FOR ALL-THREAD ROD.

G. WHERE THE DATA TRACK CROSSES BUILDING EXPANSION JOINTS, EXPANSION SPLICES SHALL ALLOW FOR 1" OF THERMAL EXPANSION AND CONTRACTION.

2.4.9.2 LOADING CAPACITIES AND TESTING:

A. CABLE TRAY SHALL MEET THE LOADING REQUIREMENTS OF NEMA 12C.

B. UPON REQUEST, MANUFACTURER SHALL PROVIDE TEST REPORTS IN ACCORDANCE WITH THE LATEST REVISION OF NEMA VE-1 OR CSA C22.2 NO. 126-M91.

2.4.9.3 SHOP DRAWINGS: PROVIDE COMPLETE SHOP DRAWINGS INDICATING ALL CABLE TRAYS, DEVICES, SUPPORT POINTS, OFFSETS AND TRANSITIONS. DRAWINGS SHALL BE 1/8" SCALE. BASE SHEETS WILL BE PROVIDED BY THE ENGINEER.

2.3.9.4 CABLE TRAY SHALL BE CABLOFIL OR APPROVED EQUAL.

2.5 RACEWAY FITTINGS:

2.5.1 INTERMEDIATE METAL CONDUIT SHALL HAVE THREADED GALVANIZED STEEL FITTINGS; THREADLESS, COMPRESSION, GALVANIZED STEEL FITTINGS OR THREADLESS, COMPRESSION, CADMIUM PLATED MALLEABLE IRON FITTINGS. FITTINGS SHALL BE RAIN TIGHT/CONCRETE TIGHT. ALL FITTINGS FOR EXTERIOR CONDUIT SHALL BE THREADED.

2.5.2 RIGID METAL CONDUIT SHALL HAVE THREADED FITTINGS, GALVANIZED STEEL OR THREADLESS COMPRESSION GALVANIZED STEEL OR THREADLESS COMPRESSION CADMIUM PLATED MALLEABLE IRON. FITTINGS SHALL BE RAIN TIGHT/CONCRETE TIGHT. ALL FITTINGS FOR EXTERIOR CONDUIT SHALL BE THREADED.

2.5.3 RIGID NON-METALLIC CONDUIT SHALL HAVE POLYVINYL CHLORIDE (PVC) FITTINGS SUITED FOR THE PURPOSE AND JOINED TOGETHER BY A METHOD APPROVED FOR THE PURPOSE. SCHEDULE 80 CONDUIT SECTIONS MAY BE JOINED TOGETHER WITH THREADED FITTING CONNECTORS.

2.5.4 ELECTRICAL METALLIC TUBING (EMT) FITTINGS SHALL BE COMPRESSION TYPE, ALL ZINC PLATED STEEL; ZINC PLATED STEEL BODY WITH CADMIUM PLATED MALLEABLE IRON NUT OR CADMIUM PLATED MALLEABLE IRON BODY AND COMPRESSION NUT. FITTINGS SHALL BE UL LISTED FOR RAIN TIGHT, CONCRETE TIGHT OR RAIN TIGHT/CONCRETE TIGHT. DIE CAST OR INDENTER TYPE FITTINGS SHALL NOT BE PERMITTED.

2.5.5 FLEXIBLE METAL CONDUIT FITTINGS SHALL BE ZINC PLATED STEEL OR CADMIUM PLATED MALLEABLE IRON SCREW TYPE WITH INSULATED THROAT AND ANGULAR WEDGE FITTING BETWEEN CONVOLUTIONS OF CONDUIT.

2.5.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT FITTINGS SHALL BE CADMIUM PLATED, MALLEABLE IRON OR STEEL WITH COMPRESSION TYPE STEEL FERRULE AND NEOPRENE GASKET SEALING RINGS, WITH INSULATED THROAT.

2.5.7 SURFACE RACEWAY FITTINGS SHALL BE STEEL WITH RUST RESISTANT UNDERCOAT AND FINISH COAT TO MATCH THE SURFACE RACEWAY. THE FITTINGS SHALL BE SO DESIGNED THAT THE SECTIONS CAN BE ELECTRICALLY AND MECHANICALLY COUPLED TOGETHER WITHOUT SUBJECTING THE CONDUCTORS TO ABRASION.

2.5.8 WIREWAY FITTINGS SHALL BE STEEL WITH RUST RESISTANT UNDERCOAT AND FINISH COAT TO MATCH THE WIREWAY. THE FITTINGS SHALL BE SO DESIGNED THAT THE SECTIONS CAN BE ELECTRICALLY AND MECHANICALLY FITTED TOGETHER TO FORM A COMPLETE SYSTEM. DEAD ENDS SHALL BE CLOSED.

2.5.9 COUPLINGS AND UNIONS SHALL BE GALVANIZED STEEL, TAPERED THREAD STANDARD CONDUIT COUPLINGS FOR INTERMEDIATE METAL CONDUIT AND RIGID METAL CONDUIT. PVC COUPLINGS FOR RIGID NON-METALLIC CONDUIT SHALL USE APPROVED ADHESIVE, AND THREADED COUPLINGS SHALL BE USED FOR SCHEDULE 80 CONDUIT. SPLIT COUPLINGS SHALL BE GALVANIZED STEEL. UNIONS SHALL BE GROUND JOINT TYPE GALVANIZED STEEL.

2.6 BUSHINGS:

2.6.1 BUSHINGS SHALL BE ONE OF THE FOLLOWING TYPES:

1. ZINC PLATED STEEL, THREADED OR THREADLESS
2. ZINC PLATED STEEL OF THREADED OR THREADLESS, PHENOLIC INSULATED WITH TEMPERATURE RATING OF 150°C
3. CADMIUM PLATED MALLEABLE IRON, THREADED OR THREADLESS
4. CADMIUM PLATED MALLEABLE IRON, THREADED OR THREADLESS, PHENOLIC INSULATED, WITH TEMPERATURE RATING OF 150°C
5. PHENOLIC WITH TEMPERATURE RATING OF 150°C
6. ZINC PLATED STEEL, OR CADMIUM PLATED MALLEABLE IRON; THREADED OR THREADLESS; NON-INSULATED OR INSULATED WITH GROUNDING CONNECTOR OR GROUNDING LUG

2.6.2 INSULATED BUSHINGS SHALL HAVE PHENOLIC INSULATION MOLDED TO THE BUSHING

2.7 CONDUIT SEALS: CONDUIT SEALS SHALL BE GALVANIZED STEEL, TAPERED THREAD FOR INTERMEDIATE METAL CONDUIT AND RIGID METAL CONDUIT WITH SEALING COMPOUND AND FIBER.

2.8 BOXES: ALL BOXES SHALL BE 4"X 4" X 1-1/2" DEEP OR LARGER.

2.8.1 FOR INDOOR WORK, FLUSH TYPE JUNCTION, OUTLET AND SWITCH BOXES SHALL BE GALVANIZED PRESSED STEEL.

2.8.2 JUNCTION BOXES FOR EXPOSED WORK SHALL BE FS OR FD TYPE. BOXES SHALL BE THREADED, CADMIUM PLATED MALLEABLE IRON WITH WEATHERPROOF GALVANIZED STEEL OR STAINLESS STEEL COVER AND NEOPRENE COVER GASKETS.

2.8.3 BOXES FOR EXPOSED WORK IN INDOOR FINISHED SPACES SHALL BE FS OR FD TYPE, WITH THE APPROPRIATE COVERS FOR THE DEVICE AND LOCATION. SURFACE TYPE PRESSED STEEL BOXES SHALL BE USED IN NONFINISHED SPACES ONLY.

2.8.4 FABRICATED BOXES SHALL BE STEEL WITH INSIDE AND OUTSIDE SURFACES COATED WITH CORROSION-RESISTANT PAINT OR WEATHER RESISTANT COATING. COVERS SHALL BE HINGED OR SCREWED WITH OR WITHOUT GASKETS DEPENDING ON LOCATION. ALL EXTERIOR BOXES SHALL BE RATED NEMA 3R. BOXES SHALL BE SIZED TO MEET THE NEC ARTICLE 370-6 FILL REQUIREMENTS.

2.9 CABINETS: CABINETS SHALL BE FLUSH OR SURFACE MOUNTED AS INDICATED ON THE DRAWINGS, AND FABRICATED OF CODE GAUGE GALVANIZED STEEL WITH TURNED LIP

ON FRONT. COVER SHALL BE FLAT STEEL SHEET WITH HINGED DOOR (CONCEALED HINGES) AND FLUSH CATCH AND LOCK. ALL CABINETS FOR THE PROJECT SHALL BE KEYED ALIKE. COVER SHALL BE TREATED WITH RUST-RESISTANT UNDERCOAT AND GREY BAKED FINISH COAT.

2.10 CONDUCTORS:

2.10.1 CONDUCTORS SHALL BE 98% CONDUCTIVITY COPPER, MEDIUM OR SOFT DRAWN. SIZES SHALL BE AS INDICATED ON THE DRAWINGS. SIZES NO. 10 AND SMALLER MAY BE SOLID UNLESS NOTED ON THE DRAWINGS. SIZES NO. 8 AND LARGER SHALL BE STRANDED. INSULATION MAY BE THW, THWN OR XHHW UNLESS NOTED OTHERWISE ON THE DRAWINGS.

2.10.2 CONDUCTOR IDENTIFICATION: CONDUCTOR SIZE NO. 6 AND SMALLER SHALL BE FACTORY COLORED INSULATION. CONDUCTORS LARGER THAN NO. 6 MAY HAVE FACTORY COLORED INSULATION OR BLACK INSULATION WITH COLOR CODED IDENTIFICATION TAPE. IN WIREWAYS AND JUNCTION BOXES WHERE MULTIPLE CIRCUITS EXIST, IDENTIFY EACH CONDUCTOR WITH IT'S SOURCE AND LOAD.

2.10.3 REFER TO THE SECTION "CONDUCTOR AND CABLE IDENTIFICATION" FOR COLOR CODING AND IDENTIFICATION OF CONDUCTORS.

2.10.4 IDENTIFICATION TAGS OR LABELS SHALL BE VINYL COATED, WITH 1/8" MINIMUM HEIGHT, BLACK CHARACTERS ON WHITE BACKGROUND. TAG OR LABEL SHALL BE 1/4" WIDE MINIMUM. NOT TO BE CONFUSED WITH TAGS SPECIFIED IN SECTION 16010 – ELECTRICAL GENERAL

2.10.5 WIRE CONNECTORS FOR 600 VOLT CONDUCTORS SIZE NO. 18 TO NO. 6 AWG SHALL BE PRESSURE TYPE, SPRING CONNECTORS. USE 600 VOLT SPLICER-REDUCER PRESSURE CONNECTORS FOR COPPER CONDUCTORS TO 500 MCM. USE RECTANGULAR, SOLDERLESS PRESSURE CONNECTORS OR SPLIT BOLT COPPER ALLOY CONNECTORS FOR COPPER CONDUCTORS TO 1000 MCM.

2.10.6 WIRE PULLING LUBRICANT SHALL BE A PRODUCT PRODUCED SPECIFICALLY FOR WIRE PULLING LUBRICATION.

2.11 GROUND RODS: GROUND RODS SHALL BE COPPER CLAD STEEL, 3/4" DIAMETER, 10' LENGTH MINIMUM OR AS INDICATED ON THE DRAWINGS. USE EXOTHERMIC WELDING TO CONNECT GROUNDING CONDUCTOR TO GROUND ROD.

2.12 SLEEVES: SLEEVES SHALL BE GALVANIZED METAL FLANGED TYPE OR SCHEDULE 40 GALVANIZED STEEL PIPE.

2.13 CONCRETE INSERTS: CONCRETE INSERTS SHALL BE GALVANIZED STEEL, MINIMUM 14 GAUGE CUT TO NECESSARY LENGTH FOR THE PURPOSE. USE GALVANIZED HARDWARE.

2.14 METAL FRAMING SYSTEM:

2.14.1 STEEL CHANNEL SECTIONS SHALL BE ROLLED FROM COMMERCIAL GRADE STEEL.

2.14.2 THE CROSS-SECTIONAL WIDTH DIMENSION OF THE CHANNEL SHALL BE A MINIMUM OF 1-1/2." THE DEPTH SHALL BE SIZED TO SATISFY THE LOAD REQUIREMENTS AND DEFLECTION.

2.14.3 CHANNELS 1-1/2" IN DEPTH OR GREATER SHALL BE ROLLED FROM 12 GAUGE STEEL. CHANNELS SMALLER THAN 1-1/2" IN DEPTH MAY BE 14 GAUGE STEEL.

2.14.4 ATTACHMENT HOLES SHALL BE FACTORY PUNCHED ON HOLE CENTERS EQUAL TO THE CHANNEL CROSS-SECTIONAL WIDTH DIMENSION AND SHALL BE MAXIMUM OF 9/16" DIAMETER.

2.14.5 THE FINISH ON STEEL COMPONENTS SHALL BE ELECTRO-GALVANIZING.

2.14.6 NUTS, BOLTS, WASHERS, STRAPS, THREADED ROD AND OTHER PARTS SHALL BE PROTECTED WITH THE SAME FINISH AS THE CHANNELS.

2.15 FIRE BARRIER PENETRATION SEALS:

2.15.1 PROVIDE SEALS FOR ANY OPENING THROUGH FIRE-RATED WALLS, FLOORS, OR CEILINGS USED AS PASSAGE FOR ELECTRICAL COMPONENTS SUCH AS CONDUIT OR ELECTRICAL BOXES. REVIEW ARCHITECTURAL DRAWINGS FOR LOCATIONS OF ALL FIRE-RATED WALLS.

2.15.2 CRACKS, VOIDS, OR HOLES UP TO 4" DIAMETER SHALL BE FILLED WITH PUTTY, CAULKING, OR ONE-PIECE INTUMESCENT ELASTOMER WHICH IS NON-CORROSIVE TO METAL, COMPATIBLE WITH SYNTHETIC CABLE JACKETS, AND CAPABLE OF EXPANDING 10 TIMES WHEN EXPOSED TO FLAME OR HEAT.

2.15.3 FOR OPENINGS 4" OR GREATER USE A SEALING SYSTEM CAPABLE OF PASSING 3-HOUR FIRE TEST IN ACCORDANCE WITH ASTM E-814. SEALING SYSTEM SHALL CONSIST OF WALL WRAP OR LINER, PARTITIONS, AND END CAPS CAPABLE OF EXPANDING WHEN EXPOSED TO TEMPERATURES OF 250 TO 350°F.

2.16 PAINTING: PAINTING PRODUCTS ARE SPECIFIED IN DIVISION 9 - "FINISHES."

2.17 EQUIPMENT IDENTIFICATION: PROVIDE NAMEPLATE FOR EQUIPMENT IDENTIFICATION SIZED AS INDICATED ON THE DRAWINGS. NAMEPLATE SHALL BE 3" X 1" MINIMUM. PLATES SHALL BE LAMINATED PLASTIC (MICARTA) WITH WHITE CORE. MOUNT PLATES ON A VERTICAL SURFACE WITH A MINIMUM OF TWO NON-FERROUS POP RIVETS. NORMAL POWER NAMEPLATES SHALL BE BLACK. EMERGENCY POWER NAMEPLATES SHALL BE RED.

2.18 PULL WIRE AND PULL ROPE:

2.18.1 PULLWIRE SHALL BE GALVANIZED STEEL WIRE, NO. 14 AWG MINIMUM SIZE.

2.18.2 PULLROPE SHALL BE PLY CORD WITH 2000 LBS. TENSILE STRENGTH, MINIMUM.

2.19 TERMINAL STRIPS: TERMINAL STRIPS SHALL BE SECTIONAL BARRIER TYPE MADE OF MOLDED PHENOLIC FOR USE IN WIRING CONTROL PANELS. NUMBER OF TERMINALS AND AMPACITY SHALL BE AS INDICATED ON THE DRAWINGS. THE BINDING HEAD SHALL BE SCREW IN TYPE.

2.20 EQUIPMENT BACKBOARDS: EQUIPMENT BACKBOARDS SHALL BE EXTERIOR GRADE 3/4" PLYWOOD FINISHED ON ONE SIDE (TYPE AC). FINISH BACKBOARD ON BOTH SIDES AND ALL EDGES WITH TWO COATS OF FIRE RETARDANT GRAY PAINT BEFORE MOUNTING. THE “A” SIDE SHALL BE EXPOSED AFTER MOUNTING. MOUNT 4’ X 8’ SHEETS IN WITH 4’ EDGE STARTING AT 9’ AFF.

2.21 CONDUIT STRAPS: ALL CONDUIT STRAPS BELOW 9' AFF SHALL HAVE TWO SUPPORT POINTS. SINGLE POINT STRAPS ARE NOT ACCEPTABLE. SINGLE POINT STRAPS ARE ACCEPTABLE ABOVE CEILING AND IN MECHANICAL AND ELECTRICAL ROOMS.

3.0 EXECUTION

3.1 GENERAL:

3.1.1 MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN A NEAT AND WORKMANLIKE MANNER ACCORDING TO THE STANDARDS OF THE INDUSTRY. MATERIALS AND EQUIPMENT INSTALLED AND NOT MEETING THE STANDARDS OF THE INDUSTRY MAY BE REJECTED AND REQUIRED TO BE REMOVED AND REINSTALLED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.

3.1.2 CONTRACTOR IS RESPONSIBLE FOR THE SAFETY AND CONDITIONS OF THE MATERIALS AND EQUIPMENT INSTALLED UNTIL OWNER'S BENEFICIAL OCCUPANCY OR ACCEPTANCE.

3.1.3 MINOR LOCATION CHANGES FROM THOSE INDICATED MAY BE NECESSARY SO THAT WORK CAN CONFORM WITH THE BUILDING AS CONSTRUCTED, TO FIT WORK OF OTHER TRADES OR TO COMPLY WITH THE RULES OF AUTHORITIES HAVING JURISDICTION.

3.2 RACEWAYS:

3.2.1 INSTALL WIRING IN METALLIC RACEWAY SYSTEMS INCLUDING GROUNDING, UNLESS SPECIFICALLY INDICATED OTHERWISE IN OTHER SECTIONS HEREIN OR ON THE DRAWINGS.

3.2.2 REFER TO STRUCTURAL DRAWINGS FOR FRAMED OPENINGS FOR RACEWAYS, ETC., IN FLOORS AND ROOFS. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND PROVIDING PROPER DIMENSIONS FOR ALL REQUIRED ELECTRICAL OPENINGS.

3.2.3 LAYOUT AND INSTALL RACEWAYS WITH SUFFICIENT CLEARANCE TO PERMIT PROPER INSTALLATION.

3.2.4 INSTALL RACEWAYS STRAIGHT AND PLUMB. SQUARELY CUT CONDUIT AND PROPERLY REAM TO REMOVE ALL CONSTRICTION AND BURRS BEFORE MAKING UP JOINTS. PAINT EXPOSED THREADS TO RETARD RUSTING. BENDING OF CONDUIT WITH A PIPE TEE OR VISE IS PROHIBITED.

3.2.5 EMT CONDUIT SHALL BE INSTALLED ONLY IN INTERIOR SPACES AND IN CONCRETE SLABS ABOVE GRADE. EMT INSTALLED IN CONCRETE SHALL HAVE CONCRETE TIGHT FITTINGS.

3.2.6 MAXIMUM SIZE OF EMT SHALL BE 4". MINIMUM SIZE SHALL BE 1/2" UNLESS NOTED OTHERWISE ON THE DRAWINGS. EMT SHALL ONLY BE USED WITH CABLES RATED 600 VOLTS OR LESS.

3.2.7 RACEWAYS IN HAZARDOUS AREAS SHALL BE RIGID METAL CONDUIT.

3.2.8 RACEWAYS BELOW GRADE AND IN CONCRETE SLABS AT OR BELOW GRADE TO A POINT 2” ABOVE CONCRETE FLOOR SHALL BE RIGID METAL CONDUIT. POWER RACEWAYS GREATER THAN 1" MAY BE PVC, AT THE CONTRACTOR'S OPTION. COMMUNICATION, LOW VOLTAGE AND FIRE ALARM RACEWAYS SHALL BE RUN OVERHEAD WITHIN THE BUILDING EXCEPT FOR CONNECTION TO FLOOR BOXES.

COMMUNICATION, LOW VOLTAGE OR FIRE ALARM RACEWAYS THAT EXIT FROM UNDER THE BUILDING SLAB SHALL BE METALLIC. ALL EXPOSED RACEWAYS PENETRATING CONCRETE SLAB SHALL BE RIGID METAL CONDUIT. IF PVC IS USED UNDERGROUND, ELBOWS AND RISERS THROUGH GRADE OR SLAB SHALL BE RIGID METAL CONDUIT WITH 2 COATS OF BITUMASTIC. ANY RACEWAY NOT MEETING THIS REQUIREMENT SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE. ADDITIONAL CONSTRUCTION TIME AND COMPENSATION FOR THE CORRECTION OF THE DEFICIENCY WILL NOT BE ALLOWED.

3.2.9 RIGID METAL CONDUIT INSTALLED IN CONCRETE OR UNDERGROUND SHALL BE MADE WATERTIGHT BY APPLYING COMPOUND TO THE THREADS OR USING CONCRETE-TIGHT THREAD-LESS FITTINGS WHEN INSTALLED IN CONCRETE, OR USING RAIN-TIGHT THREADLESS FITTINGS WHEN INSTALLED ON OUTSIDE WALLS OR IN WET LOCATIONS.

3.2.10 RIGID METAL CONDUIT INSTALLED UNDERGROUND SHALL BE PAINTED WITH TWO COATS OF ALKALI AND ACID RESISTANT PAINT SUCH AS BITUMASTIC OR EQUAL. COATING SHALL NOT BE DILUTED.

3.2.11 PVC COATED RIGID METAL CONDUIT MAY BE PROVIDED AS AN OPTION IN LIEU OF THE TWO COATS OF THE ALKALI AND ACID RESISTANT PAINT. THE JOINTS SHALL BE PROTECTED WITH PVC TAPE APPLIED AFTER THE JOINTS ARE MADE. TOOLS FOR THE PURPOSE SHALL BE USED IN MAKING UP THE JOINTS SO AS NOT TO DAMAGE THE COATING.

3.2.12 CONDUIT MAY BE EXPOSED IN EQUIPMENT ROOMS, VERTICAL CHASES, MECHANICAL AND ELECTRICAL ROOMS, OTHER SIMILAR SPACES NOT NORMALLY HABITABLE OR EXPOSED TO PUBLIC VIEW, AND WHERE ELECTRICAL DRAWINGS SPECIFICALLY NOTE "EXPOSED CONDUIT." PVC CONDUIT IN THESE AREAS IS UNACCEPTABLE.

3.2.13 RACEWAYS SHALL BE SUPPORTED BY APPROVED TYPES OF GALVANIZED WALL BRACKETS, CEILING TRAPEZE WITH THREADED ROD SUPPORT, OR PIPE STRAPS. CONDUIT SHALL NOT BE SUPPORTED AT ANY POINT BY WIRE OR WIRE CLIPS.

3.2.14 JOB CUT THREADS SHALL BE GIVEN A COAT OF RUST RESISTANT PAINT SUCH AS ZINC CHROMATE OR EQUAL.

3.2.15 CONDUIT IN MASONRY SHALL BE INSTALLED AHEAD OF THE MASONS.

3.2.16 CUTTING OF CHASES IS PROHIBITED.

3.2.17 CONDUIT SHALL BE CLOSED DURING CONSTRUCTION TO PREVENT ENTRANCE OF FOREIGN MATERIAL. AFTER THE BUILDING HAS BEEN DRIED IN, ALL CONDUITS SHALL BE CLEANED SO THAT THEY ARE FREE OF ANY FOREIGN MATERIAL AND WATER.

3.2.18 FLEXIBLE METAL CONDUIT SHALL BE INSTALLED ONLY IN DRY LOCATIONS AND SHALL BE OF NOMINAL TRADE SIZE NOT LESS THAN 1/2" OR AS PERMITTED BY "EXCEPTIONS" IN NEC. FLEXIBLE METAL CONDUIT SHALL BE USED WITH UL APPROVED TYPE FITTINGS. FLEXIBLE METAL CONDUIT SHALL BE USED AS A RACEWAY FOR MOTORS, TRANSFORMERS, OR OTHER EQUIPMENT THAT MAY BE PROVIDED WITH AN ADJUSTABLE MOUNTING OR VIBRATION BASE.

3.2.19 LIQUIDTIGHT FLEXIBLE METAL CONDUIT SHALL BE INSTALLED IN WET LOCATIONS, IN BOTH CONCEALED AND EXPOSED WORK, WHERE REQUIRED FOR PROTECTION FROM LIQUIDS, VAPORS OR SOLIDS. LIQUIDTIGHT FLEXIBLE METAL CONDUIT SHALL BE USED AS A RACEWAY FOR MOTORS, TRANSFORMERS OR OTHER EQUIPMENT THAT

MAY BE PROVIDED WITH AN ADJUSTABLE MOUNTING OR VIBRATION BASE. THE LIQUIDTIGHT FLEXIBLE METAL CONDUIT RUN SHALL BE KEPT TO A MINIMUM AT ALL LOCATIONS. WHERE FLEXIBLE CONDUIT RUN EXCEEDS FOUR FEET, RACK MOUNT RIGID METALLIC CONDUIT TO THE EQUIPMENT AND THEN EXTEND WITH FLEXIBLE METAL CONDUIT.

3.2.20 SURFACE RACEWAY AND FITTINGS SHALL BE INSTALLED IN DRY LOCATIONS.

3.2.21 WIREWAYS AND WIREWAY FITTINGS SHALL BE USED FOR EXPOSED WORK AND WHEN INSTALLED OUTDOORS OR IN WET LOCATIONS SHALL BE APPROVED WEATHERPROOF CONSTRUCTION.

3.2.22 EXPANSION FITTINGS SHALL BE PROVIDED FOR RACEWAYS TO COMPENSATE FOR THERMAL EXPANSION AND CONTRACTION IN CONDUIT RUNS 200 FEET OR GREATER AND AT BUILDING EXPANSION JOINTS. BONDING JUMPERS SHALL BE PROVIDED FOR ELECTRICAL CONTINUITY OF THE RACEWAY SYSTEM AT THE EXPANSION FITTINGS.

3.2.23 BUSHINGS SHALL BE PROVIDED AT THE END OF ALL CONDUITS TO PROTECT THE INSULATION OF THE CONDUCTOR. PROVIDE GROUNDING BUSHINGS FOR METAL RACEWAYS, BOXES, CABINETS TO INSURE THAT ALL METALLIC SURFACES ARE EFFECTIVELY GROUNDED. METALLIC RACEWAY MAY BE BONDED TO CABINETS, BOXES AND PANELBOARDS BY DOUBLE LOCKNUT AND BUSHING TO ENSURE THE METALLIC PARTS ARE ALL EFFECTIVELY GROUNDED.

3.2.24 CONDUIT OR RACEWAYS THROUGH WHICH MOISTURE MAY ENTER AND CONTACT ENERGIZED LIVE PARTS SHALL BE SEALED OR PLUGGED AT EITHER OR BOTH ENDS WITH CONDUIT SEALS WHERE PORTIONS OF AN INTERIOR RACEWAY SYSTEM ARE EXPOSED TO WIDELY DIFFERENT TEMPERATURES, E.G., CIRCULATION OF AIR FROM A WARMER TO A COOLER SECTION THROUGH THE RACEWAY SHALL BE PREVENTED BY CONDUIT SEALS.

3.2.25 INSTALL PULL BOXES IN CONDUIT AT INTERVALS OF 200 FEET OR LESS EXCEPT WHEN THESE INTERVALS WILL PLACE THE PULL BOX COVER IN A FINISHED FLOOR AREA OR NON-ACCESSIBLE PLACE, THE INTERVAL MAY BE EXTENDED TO A MAXIMUM DISTANCE OF 300 FEET. REQUEST FOR EACH DEVIATION OR EXTENSION OF INTERVAL SHALL BE MADE AND APPROVAL GRANTED BY THE ENGINEER BEFORE PROCEEDING WITH THE INSTALLATION. IF ANY CONDUIT RUN IS FOUND TO BE GREATER THAN 300 FEET AND THE CONTRACTOR HAS NOT SECURED PRIOR APPROVAL FROM THE ENGINEER, A NEW RACEWAY SHALL BE INSTALLED TO REPLACE THE DEFICIENT ONE AT THE CONTRACTOR'S EXPENSE.

3.2.26 UNDERGROUND WORK:

1. EXCAVATION AND BACKFILLING FOR UNDERGROUND CONDUIT SYSTEMS SHALL BE IN ACCORDANCE WITH DIVISION 2 "SITEWORK" AND SECTION ON "EXCAVATION AND BACKFILL." MINIMUM COVER FOR EXTERIOR UNDERGROUND CONDUIT SHALL BE 30" OVER CONDUIT UNLESS OTHERWISE NOTED ON THE DRAWINGS.

2. PLACE COLOR CODED METALLIC IDENTIFICATION TAPE APPROXIMATELY 12" ABOVE ALL UNDERGROUND SYSTEMS. TAPE SHALL BE CONTINUOUSLY PRINTED WITH "CAUTION" IN LARGE BOLD LETTERS. A SECOND PRINTED LINE SHALL INDICATE THE TYPE OF CABLE BENEATH (I.E. 12 KV, 480 V, 208V, TELEPHONE, ETC). USE YELLOW TAPE FOR ELECTRIC AND GREEN FOR TELEPHONE.

3. ALL RACEWAYS, OTHER THAN THOSE FOR POWER, EXITING FROM UNDER THE BUILDING SLAB SHALL BE METALLIC AS ALLOWED BY THE NEC.

3.2.27 CONDUIT INSTALLED IN CONCRETE:

1. CONFORM TO APPLICABLE PORTION OF SECTION 703 OF ACI STANDARD CODE FOR REINFORCED CONCRETE.

2. LOCATE CONDUITS IN CENTER THIRD OF CONCRETE SLAB THICKNESS. OUTSIDE CONDUIT DIAMETER NOT TO EXCEED 1/3 CONCRETE SLAB THICKNESS. INSTALL NO CONDUIT IN CONCRETE SLABS OF LESS THAN 3" THICK.

3. CONDUITS IN CONCRETE SLABS SHALL NOT CROSS AT AN ANGLE OF LESS THAN 45 DEGREES.

4. CONDUITS SHALL NOT PASS THROUGH BEAMS EXCEPT WHEN SHOWN ON THE DRAWINGS.

5. SPACE VERTICAL INSTALLATION OF CONDUIT THROUGH CONCRETE SLABS NOT CLOSER THAN THREE DIAMETER ON CENTER.

6. WHERE CONDUITS RISE THROUGH FLOOR SLABS, CURVED PORTION OF BENDS SHALL NOT BE VISIBLE ABOVE FINISH FLOOR.

7. CONDUIT SUPPORTS MAY NOT BE USED TO SUPPORT CONDUIT PASSING THROUGH SLABS ON GRADE UNLESS THE OPEN ENDS OF CONDUIT HAVE BEEN FILLED WITH NP-1 SEALANT PRIOR TO CALLING FOR A TERMITE TREATMENT INSPECTION. FAILURE TO ADHERE WITH THIS REQUIREMENT WILL RESULT IN THE TERMITE TREATMENT BEING CANCELED. A REINSPECTION FEE OF $500.00 PAYABLE TO THE ARCHITECT MUST BE RECEIVED PRIOR TO RESCHEDULING A TERMITE TREATMENT INSPECTION.

3.2.28 CLEANING: CLEAN CONDUIT SYSTEMS BY WIRE RAT BRUSH AND MANDREL. TOTALLY REMOVE ALL MOISTURE PRIOR TO BUILDING FINISHES BEING INSTALLED.

3.2.29 CABLE TRAY INSTALLATION: INSTALL AND GROUND PER NFPA 70, ARTICLE 318. INSTALL CABLE TRAYS PARALLEL WITH OR AT RIGHT ANGLES TO CEILINGS, WALLS, AND STRUCTURAL MEMBERS. SUPPORT AT 8' INTERVALS UNLESS NOTED OTHERWISE. CONTACT SURFACES OF ALUMINUM CONNECTIONS SHALL BE COATED WITH AN ANTIOXIDANT COMPOUND PRIOR TO ASSEMBLY. ADJACENT CABLE TRAY SECTIONS SHALL BE BONDED TOGETHER BY CONNECTOR PLATES OF AN IDENTICAL TYPE AS THE CABLE TRAY SECTIONS. FOR GROUNDING OF CABLE TRAY SYSTEM PROVIDE A NO. 1/0 AWG BARE ALUMINUM WIRE THROUGHOUT CABLE TRAY SYSTEM, AND BOND TO EACH SECTION. TERMINATE CABLE TRAYS 12 INCHES FROM BOTH SIDES OF SMOKE AND FIRE PARTITIONS. CONDUCTORS RUN THROUGH SMOKE AND FIRE PARTITIONS SHALL BE INSTALLED IN 3" RIGID STEEL CONDUITS WITH GROUNDING BUSHINGS, EXTENDING 12" BEYOND EACH SIDE OF THE PARTITIONS OR TO THE CABLE TRAY IF INDICATED ON THE DRAWINGS. SEAL CONDUIT ON BOTH ENDS TO MAINTAIN SMOKE AND FIRE RATINGS OF PARTITIONS. BOND THE CABLE TRAY BOND TO BUILDING STEEL AND TO THE ELECTRICAL SYSTEM GROUND.

3.3 BOXES:

3.3.1 ATTACH BOXES TO CONCRETE FORMWORK, OR TO OTHER SURROUNDING BUILDING MATERIAL. PROVIDE ADDITIONAL JUNCTION AND PULL BOXES WHERE INJURY TO

INSULATION OR DEFORMATION OF WIRE WOULD OCCUR DUE TO EXCESSIVE PULLING RESISTANCE. WHEN SEVERAL FEEDERS PASS THROUGH A COMMON PULL BOX, TAG EACH FEEDER SEPARATELY, INDICATING ELECTRICAL CHARACTERISTICS AND DESTINATION.

1. BOXES SHALL BE ACCURATELY LOCATED. CONSULT ARCHITECTURAL PLANS FOR DIMENSIONS.

2. MOUNT BOXES IN THE COURSE NEAREST TO THE HEIGHT SPECIFIED WHEN INSTALLED IN FINISHED BLOCK, BRICK OR TILE WALLS. IF THIS WILL CONFLICT WITH WALL MOUNTED ITEMS, DO NOT PROCEED AND NOTIFY ARCHITECT IN ORDER TO OBTAIN DIRECTION.

3. BOXES FOR USE WITH RACEWAY SYSTEMS SHALL BE MINIMUM 1 1/2 INCHES DEEP, EXCEPT WHERE SHALLOWER BOXES REQUIRED BY STRUCTURAL CONDITIONS ARE APPROVED. BOXES FOR OTHER THAN LIGHTING FIXTURE OUTLETS SHALL BE MINIMUM 4 INCHES SQUARE, EXCEPT 4-BY-2 INCH BOXES MAY BE USED WHERE ONLY ONE RACEWAY ENTERS OUTLET.

4. PULL BOXES SHALL BE AT LEAST THE MINIMUM SIZE REQUIRED BY NFPA 70 AND OF CODE-GAUGE GALVANIZED SHEET STEEL, OR COMPATIBLE WITH NONMETALLIC RACEWAY SYSTEMS, EXCEPT WHERE CAST-METAL BOXES ARE REQUIRED IN LOCATIONS SPECIFIED HEREIN. FURNISH BOXES WITH SCREW-FASTENED COVERS. WHERE SEVERAL FEEDERS PASS THROUGH A COMMON PULL BOX, TAG FEEDERS TO INDICATE CLEARLY ELECTRICAL CHARACTERISTICS, CIRCUIT NUMBER, AND PANEL DESIGNATION.

5. EXTENSION RINGS SHALL NOT BE USED. ANY EXTENSION RINGS FOUND SHALL BE REMOVED AT THE CONTRACTOR'S EXPENSE.

3.3.2 RECESSED INSTALLATION: BOXES AND COVERS SHALL BE INSTALLED SO THAT THE COVERS ARE FLUSH WITH THE FINISHED SURFACES. BOXES IN MASONRY OR TILE CONSTRUCTION SHALL HAVE MASONRY BOXES OR BOXES WITH SQUARE CUT TILE COVERS. DO NOT CUT CONCRETE BLOCK THROUGH ITS ENTIRETY IN ORDER TO ACCOMMODATE ANY TYPE BOX. "HANDY" BOXES SHALL NOT BE USED.

3.3.3 BOXES IN PARTITIONS: THROUGH TYPE BOXES ARE NOT PERMITTED EXCEPT WHERE SHOWN ON ELECTRICAL DRAWINGS. RECESSED OUTLET BOXES, CABINETS, CONSOLES, ETC., WHEN SHOWN LOCATED BACK-TO-BACK SHALL BE PROVIDED WITH 1/2" FIBERGLASS INSULATION BETWEEN THE BOXES. OUTLETS AND DEVICES IN FIRE RATED WALLS SHALL NOT BE INSTALLED BACK TO BACK.

3.3.4 LIGHTING OUTLETS:

1. COORDINATE LOCATION OF ELECTRICAL OUTLETS WITH ARCHITECTURAL FEATURES OF THE BUILDING AND WITH THE EQUIPMENT OF OTHER TRADES.

2. PANELED OR PATTERNED CEILINGS SHALL HAVE OUTLETS LOCATED ACCORDING TO THE CEILING PATTERN.
3. BOXES MOUNTED BETWEEN BAR JOISTS OR "T" BARS SHALL BE SUPPORTED FROM TWO BARS OR JOISTS.

4. MOUNTING HEIGHTS OF WALL LIGHTING OUTLETS SHALL BE AS LISTED BELOW EXCEPT WHEN OTHERWISE INDICATED ON THE DRAWINGS OR LOCATION MAY CONFLICT WITH WALL MOUNTED ITEMS.

GENERAL - 7'6" ABOVE THE FINISHED FLOOR.
OVER DOORS - 18" TO CENTER ABOVE DOOR.
PENDANT FIXTURES - 8'0" ABOVE FINISHED FLOOR.
HEIGHT MAY BE ADJUSTED TO ALLOW WALL BLOCKS TO BE CUT TO NEAREST EDGE. MOUNTING HEIGHTS IN AREAS WITH CEILINGS GREATER THAN 10' THE MOUNTING HEIGHT SHALL BE 2' BELOW THE CEILING OR 12', WHICH EVER IS LOWER. CONTRACTOR SHALL VERIFY ALL MOUNTING HEIGHTS WITH ENGINEER PRIOR TO ROUGH-IN.

3.4 WIRING:

3.4.1 GENERAL: CONDUCTORS SHALL NOT BE INSTALLED UNTIL CONDUIT SYSTEM IS COMPLETE. BENDING RADIUS OF INSULATED WIRE OR CABLE SHALL NOT BE LESS THAN THE MINIMUM RECOMMENDED BY WIRE OR CABLE MANUFACTURER. MAXIMUM PULLING TENSION OF ANY WIRE OR CABLE SHALL NOT EXCEED MANUFACTURER'S RECOMMENDED VALUES. DO NOT INJURE INSULATION WHILE INSTALLING WIRE IN CONDUITS.

3.4.2 COLOR CODING: CONDUCTORS OF SIZE NO. 6 AND SMALLER SHALL HAVE COLOR CODED INSULATION. SIZES LARGER THAN NO. 6 MAY HAVE COLOR CODED INSULATION OR COLOR CODED TAPE FOR THE PURPOSE. SHOULD TAPE BE USED, COVER NOT LESS THAN 2" OF CONDUCTOR WITHIN THE ENCLOSURE.

3.4.3 SWITCHLEG CONDUCTORS SHALL BE A COLOR OTHER THAN WHITE, GREEN OR THE PHASE OR LINE COLOR.

3.4.4 GREEN SHALL BE USED ONLY AS THE GROUNDING CONDUCTOR. WHITE OR GRAY SHALL BE USED ONLY AS THE GROUNDED CONDUCTOR WHICH IS THE NEUTRAL CONDUCTOR. THE NEUTRAL SHALL NOT BE USED AS THE GROUNDING CONDUCTOR OR THE GROUNDING CONDUCTOR SHALL NOT BE USED AS THE NEUTRAL.

3.4.5 WHEN MORE THAN ONE NEUTRAL IS INSTALLED IN A SINGLE RACEWAY, THE FIRST NEUTRAL SHALL BE IDENTIFIED WITH WHITE COLOR, AND THE SECOND NEUTRAL SHALL BE IDENTIFIED WITH GRAY COLOR.

3.4.6 INTERCOMMUNICATIONS, COMMUNICATIONS, TEMPERATURE CONTROL, AND FIRE ALARM CONDUCTORS SHALL BE COLOR CODED OR PERMANENTLY TAGGED FOR IDENTITY. IF TAGGED, CONDUCTOR COLORS SHALL NOT INCLUDE WHITE, GRAY OR GREEN BASE COLOR OR STRIPES. COLORS SHALL COMPLY WITH THE INSULATED POWER CABLE ENGINEERS ASSOCIATION (IPCEA) METHOD K-2. CHART IS INCLUDED WITH SECTION 16101, "CONDUCTOR AND CABLE IDENTIFICATION."

3.4.7 CONDUCTORS IN PARALLEL: CONDUCTORS CONNECTED IN PARALLEL (ELECTRICALLY JOINED AT BOTH ENDS TO FORM A SINGLE CONDUCTOR) SHALL BE OF THE SAME LENGTH, OF THE SAME CONDUCTOR MATERIAL, THE SAME CIRCULAR-MIL AREA, THE SAME INSULATION TYPE AND TERMINATE IN THE SAME MANNER. WHERE INSTALLED IN SEPARATE RACEWAYS OR CABLES, THE RACEWAYS OR CABLES SHALL HAVE THE SAME PHYSICAL CHARACTERISTICS.

3.4.8 WIRING IN SWITCHBOARDS, PANELBOARDS, JUNCTION CABINETS, ETC., SHALL BE NEATLY FORMED TO PRESENT A NEAT AND ORDERLY APPEARANCE. IF WIRING NOT INSTALLED IN A NEAT AND ORDERLY MANNER, THE WIRING SHALL BE REMOVED TO THE DEVICE AND NEW WIRE INSTALLED TO MEET CRITERIA.

3.4.9 A SINGLE NEUTRAL MAY BE INSTALLED FOR THREE BRANCH CIRCUITS (POWER) PROVIDED EACH OF THE THREE IS FROM A DIFFERENT PHASE. A DEDICATED NEUTRAL CONDUCTOR IS REQUIRED ON ALL LIGHTING CIRCUIT BECAUSE OF THE ELECTRONIC BALLAST. AT THE CONTRACTOR'S OPTION, AN OVERSIZED NEUTRAL (ONE WIRE SIZE GREATER THAN THE ONE SPECIFIED) MAY BE USED INSTEAD OF A DEDICATED NEUTRAL FOR THE LIGHTING CIRCUIT HOMERUN. A SINGLE NEUTRAL MAY BE INSTALLED FOR TWO CIRCUITS PROVIDED EACH IS FROM A DIFFERENT PHASE OR A DIFFERENT LINE (THIS DOES NOT APPLY TO THE LIGHTING CIRCUITS).

3.4.10 EXCEPT FOR CONTROL WIRING, THE MINIMUM SIZE OF WIRE SHALL BE NO. 12 AWG. ON ALL POWER AND LIGHTING CIRCUITS GREATER THAN 100', THE MINIMUM WIRE SIZE SHALL BE NO. 10 AWG.

3.4.11 INTERCONNECTIONS OF CONTROL WIRING SHALL BE ON IDENTIFIED NUMBERED TERMINAL STRIPS.

3.4.12 SPLICES: SPLICES SHALL BE PERMITTED IN JUNCTION BOXES, OUTLET BOXES OF OTHER PERMANENTLY ACCESSIBLE LOCATIONS. CONDUCTORS NO. 6 OR SMALLER SHALL BE SPLICED WITH DEVICES APPROVED BY UNDERWRITERS LABORATORIES, INC., AS SPLICING CONNECTORS. SPLICES IN CONDUCTORS LARGER THAN NO. 6 SHALL BE ACCOMPLISHED WITH DEVICES APPROVED BY UNDERWRITERS LABORATORIES AS PRESSURE CABLE CONNECTORS.

3.4.13 SPLICES MADE IN UNDERGROUND BOXES OR WET LOCATIONS SHALL BE MADE WITH COMMERCIAL, UL APPROVED CAST RESIN SPLICING KIT (120 VOLT CIRCUITS OR GREATER). SPLICES FOR LOW VOLTAGE CIRCUITS MAY NOT BE MADE BELOW GRADE OR IN WET/DAMP LOCATIONS.

3.5 WIRE PULLING LUBRICATION: SHALL BE USED WHEN ANY WIRE IS PULLED BY MECHANICAL MEANS. WIRE AND CABLE SHALL BE CAREFULLY HANDLED DURING INSTALLATION. SOAP FLAKES OR VEGETABLE SOAPS SHALL NOT BE USED FOR LUBRICATION.

3.6 EQUIPMENT IDENTIFICATION: SECURE TAGS AND MARKERS TO EACH ITEM OF EQUIPMENT. SECURE ALL CABINET NAMEPLATES WITH SELF-TAPPING SCREWS OR MACHINE SCREWS AND NUTS. DO NOT RELY ON ADHESIVE MOUNTING. NAME TAGS FOR EQUIPMENT OPERATED FROM NORMAL POWER SHALL BE "BLACK." NAME TAGS FOR EQUIPMENT OPERATED FROM EMERGENCY POWER SHALL BE "RED."

3.7 SLEEVES, INSERTS AND SUPPORTS:

3.7.1 EQUIPMENT SUPPORTS: CONCRETE BASES AND STRUCTURAL STEEL TO SUPPORT THIS DIVISION'S EQUIPMENT AND RACEWAYS, AND NOT SPECIFICALLY SHOWN ON STRUCTURAL OR ARCHITECTURAL DRAWINGS SHALL BE FURNISHED BY CONTRACTOR WHOSE EQUIPMENT OR RACEWAYS IS TO BE SUPPORTED. PROVIDE A RAISED REINFORCED 4" CONCRETE BASE FOR ALL FLOOR SUPPORTED EQUIPMENT, OR AS INDICATED ON THE DRAWINGS.

3.7.2 SETTING IN CONCRETE: PLACE ALL INSERTS IN CONCRETE FORMS PRIOR TO TIME CONCRETE IS POURED. IF ADDITIONAL INSERTS ARE REQUIRED IN EXISTING CONCRETE WORK, USE SELF-DRILLING SCREW ANCHORS.

3.7.3 SUPPORT SPACING: COMPLY WITH CODES AND REGULATIONS REFERENCED EARLIER AND AS FOLLOWS:

1. SUPPORT NO ELECTRICAL WORK FROM PIPING, DUCTWORK, CEILING SYSTEM, ETC. WHERE METAL DECKING IS USED, PROVIDE SUPPORTS INDEPENDENT OF DECKING SO THAT LOADS WILL NOT BE TRANSFERRED TO DECKING. DRILL THROUGH DECKING AND SECURE SUPPORTS TO CONCRETE SLAB. WHERE SUSPENDED CEILING IS PROVIDED, PROVIDE INDEPENDENT SUPPORT SYSTEM FOR ALL CONDUIT TO THE BUILDING STRUCTURE.

2. VERTICAL CONDUIT INSIDE BUILDING SHALL BE SUPPORTED AT EACH FLOOR LEVEL AND AT 10'0" INTERVALS.

3. SUPPORT CONDUIT WITHIN ONE FOOT OF CHANGES OF DIRECTION, AND WITHIN ONE FOOT OF EACH ENCLOSURE TO WHICH IT IS CONNECTED.

3.7.4 SLEEVES THROUGH ROOFS: COORDINATE SETTING WITH DIVISION 7. CONTRACTOR SETTING SLEEVES FOR HIS ELECTRICAL CONDUIT IS RESPONSIBLE FOR FILLING SLEEVE POCKETS WITH ROOF BITUMEN AND INSURING THERE IS NO MOISTURE LEAKAGE DURING ROOF GUARANTEE PERIOD.

3.8 CAULKING AND SEALS:

3.8.1 WHERE CONDUITS, WIREWAYS, AND OTHER ELECTRICAL RACEWAYS PASS THROUGH FIRE PARTITIONS, FIRE WALLS, SMOKE PARTITIONS, OR FLOORS, INSTALL A FIRE STOP THAT PROVIDES AN EFFECTIVE BARRIER AGAINST THE SPREAD OF FIRE, SMOKE AND GASES. FIRE STOP SHALL BE ROCK WOOL FIBER, SILICONE FOAM SEALANT OR APPROVED EQUAL. COMPLETELY FILL AND SEAL CLEARANCES BETWEEN RACEWAYS AND OPENINGS WITH THE FIRE STOP MATERIAL. ADHERE TO MANUFACTURER'S INSTALLATION INSTRUCTIONS.

3.8.2 AT FLOOR, EXTERIOR WALL, AND ROOF CONDUIT PENETRATIONS, COMPLETELY SEAL CLEARANCES AROUND THE CONDUIT AND MAKE WATERTIGHT.

3.9 PAINTING:

3.9.1 PAINTING FOR DIVISION 16 WORK SHALL BE BY THE DIVISION 9 FINISHES CONTRACTOR AND AS PROVIDED IN THE DIVISION 9 - FINISHES OF THE PROJECT MANUAL.

3.9.2 THE DIVISION 16 CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING WITH THE DIVISION 9 - FINISHES CONTRACTOR THE PAINTING OF THE MATERIALS AND EQUIPMENT OF DIVISION 16.

3.9.3 REFER TO THE FINISH SCHEDULE ON DRAWINGS FOR LOCATION AND TYPE OF PAINT.

3.9.4 FINISH IN AREAS NOT LISTED OR OTHERWISE NOTED SHALL BE BLACK ENAMEL.

3.9.5 HANGERS, SUPPORTS, STRUCTURAL STEEL AND EQUIPMENT THAT ARE NOT FACTORY FINISHED SHALL BE PRIME COATED AND FINISHED COATED WITH COLOR TO MATCH THE AREA IN WHICH IT WILL BE LOCATED.

3.9.6 ELECTRIC CABINETS, SWITCHBOARDS, PANELBOARDS AND EQUIPMENT THAT IS FACTORY FINISHED AND HAS DAMAGED FINISH SHALL BE TOUCHED UP TO MATCH THE FACTORY FINISH.

3.9.7 ALL SURFACES THAT ARE TO BE PAINTED SHALL BE FREE OF RUST, SCALE, OIL AND GREASE BEFORE PRIME COAT IS APPLIED.

3.10 GROUNDING: GROUND AND BOND IN ACCORDANCE WITH NEC ARTICLE 250 AND OTHER APPLICABLE ARTICLES.

3.10.1 PROVIDE AN EQUIPMENT GROUNDING CONDUCTOR WHICH SHALL BE SEPARATE FROM THE ELECTRICAL SYSTEM NEUTRAL CONDUCTOR. THE EQUIPMENT GROUNDING CONDUCTOR SHALL BE COLORED GREEN. IT SHALL BE CONTINUOUS FROM A CONNECTION AT THE SERVICE ENTRANCE EQUIPMENT GROUND TO ALL SWITCHBOARDS, DISTRIBUTION AND BRANCH PANELBOARDS. EQUIPMENT GROUNDING CONDUCTORS SHALL BE PROVIDED IN ALL BRANCH CIRCUITS SERVING CONVENIENCE OUTLETS, RECEPTACLES, PORTABLE AND PERMANENTLY INSTALLED ELECTRICAL APPLIANCES, EQUIPMENT APPARATUS AND OTHER MISCELLANEOUS METAL ENCLOSING BODIES INCLUDING LIGHT SWITCH BOXES NORMALLY WITHIN CONTACT OF PERSONNEL. BRANCH CIRCUIT GROUNDING CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE. CONNECTIONS AT PANELBOARDS, OUTLETS, EQUIPMENT AND APPARATUS SHALL BE MADE IN AN APPROVED AND PERMANENT MANNER. RESISTANCE TO GROUND SHALL NOT EXCEED 25 OHMS.

3.10.2 BOND BUSHINGS OF THE RACEWAY SYSTEM TO GROUND LUGS IN BOXES, CABINETS, MOTORS AND EQUIPMENT TO ASSURE ELECTRICAL CONTINUITY OF ALL METALLIC COMPONENTS OF THE ELECTRICAL SYSTEMS. COMPLY WITH THE REQUIREMENTS OF NEC ARTICLES 250D, 250E, 250F, 250G, 250J AND 250K.

3.11 EQUIPMENT BACKBOARDS: LOCATE EQUIPMENT BACKBOARDS WHERE INDICATED ON THE DRAWINGS. INSTALL STRAIGHT AND PLUMB. SECURE TO STRUCTURE USING SCREWS, TOGGLE BOLTS OR MASONRY ANCHORS. DO NOT USE PLASTIC OR WOOD PLUGS IN MASONRY OR CONCRETE. DO NOT INSTALL COMBUSTIBLE BACKBOARDS IN AIR HANDLING SPACE, PLENUMS OR WHERE PROHIBITED BY THE LOCAL GOVERNING AUTHORITY.

3.12 UNDERGROUND RACEWAY MARKINGS: PROVIDE MONUMENT MARKER ABOVE UNDERGROUND JUNCTION OR PULL BOXES AND AT THE ENDS OF ANY "STUB OUT" RACEWAY. SEE MONUMENT MARKER DETAIL IN THESE SPECIFICATIONS.

3.13 TESTING:

3.13.1 AT THE COMPLETION OF THE INSTALLATION OF THE CONDUCTORS OR CABLES INTO THE RACEWAY SYSTEMS, TESTS SHALL BE CONDUCTED BY "MEGGER" TO ASCERTAIN THAT THE INSULATION FOR THE CONDUCTORS OR CABLES HAS NOT BEEN DAMAGED. MEGGER TEST EACH FEEDER AND BRANCH CIRCUIT CONDUCTOR OR CABLE WITH AN INSTRUMENT CAPABLE OF PRODUCING APPROXIMATELY 500 VOLTS FOR CONDUCTORS OR CABLES INSULATED WITH 600 VOLT INSULATION.

3.13.2 THE MINIMUM INSULATION RESISTANCE SHALL BE 100 MEGOHMS PER 1000 FEET OF 500 KCMIL CONDUCTORS OR SMALLER INSULATED WITH THW OR THWN, AND 1,000 MEGOHMS PER 100 FEET OF 500 KCMIL CONDUCTORS OR SMALLER INSULATED WITH XHHW OR OTHER CROSS-LINKED INSULATION.

END OF SECTION