SECTION 16110- CONDUITS

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Rigid metal conduit and fittings.

B. Intermediate Metal Conduit and fittings

C. Electrical metallic tubing and fittings.

D. Flexible metal conduit and fittings.

E. Liquid tight flexible metal conduit and fittings.

F. Non-metallic conduit and fittings.

1.02 RELATED SECTIONS

A. Section 16120- WIRES AND CABLES

B. Section 16450- GROUNDING

1.03 REFERENCES

The materials and installation shall comply with the latest edition of following References:

A. ANSI C80.1 and UL 6 - Rigid Steel Conduit, Zinc Coated (RMC).

B. ANSI C80.3 and UL 797 - Electrical Metallic Tubing, Zinc Coated (EMT).

C. ANSI C80.5 and UL 6A - Rigid Aluminum Conduit (ARC).

D. ANSI C80.6 and UL 1242 – Intermediate Metal Conduit, Zinc Coated (IMC)

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, EMT and Cables.

F. NFPA 70 - National Electrical Code (NEC).

G. WW-C-566 - Flexible Metal Conduit.

H. NEMA RN 1 and UL 6 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

I. NEMA TC 2 and UL 651– Electrical Rigid Polyvinyl Chloride (PVC) Conduit

J. NEMA TC3 – PVC Fittings for use with Rigid PVC Conduit and Tubing.

1.04 SUBMITTALS

A. Submit product data for materials and equipment Subcontractor proposes to use, in accordance with Section 01010.

B. Products for which tests have been established by the Underwriter's Laboratories, Inc. shall have been labeled or listed by that body, or an equivalent testing firm, acceptable to the University, and shall bear its label of approval.

1.05 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in unopened cartons or bundles as appropriate, clearly identified with manufacturer's name, Underwriter's or other approved label, grade or identifying number.

PART 2: PRODUCTS

2.01 RIGID METAL CONDUITS (RMC AND IMC) AND FITTINGS

A. Rigid Steel Conduit: ANSI C80.1 and UL 6, RMC full-weight pipe, hot-dip galvanized with threaded ends, top coated outside to protect against white rust, coupling on one end, plastic cap on both ends; Republic Conduit, Allied Tube and Conduit, Wheatland Tube Company or equal.

B. Rigid Aluminum Conduit: ANSI C80.5 and UL 6A; ARC, full-weight pipe, built to the same standards as rigid steel conduit with threaded ends, coupling on one end, plastic caps on both ends; Republic Conduit, Allied Tube and Conduit, Wheatland Tube Company or equal..

C. Intermediate Metal Conduit: ANSI C80.6 and UL 1242, IMC, high strength steel metal pipe, hot dip galvanized with threaded ends, top coated to avoid white rust, coupling on one end, plastic caps on both ends, interior coated with highly corrosion resistant lubricating finish for easier wire pulling; Republic Conduit, Allied Tube and Conduit, Wheatland Tube Company or equal.

D. PVC Externally Coated Conduit: NEMA RN 1 and UL 6; rigid steel conduit with external 0.040-inch exterior gray PVC coating and internal galvanized surface, PVC coated coupling on one end, plastic cap on both ends; Perma-Cote, Kor-Kap or equal.

E. Fittings and Conduit Bodies: NEMA FB 1; threaded type, fitting material shall match conduit material, with gasketed cover; O-Z Gedney Form 7 or equal. Threadless fittings are not acceptable for RMC and IMC.

F. Watertight Expansion and Deflection Fittings: Provide fittings at each building expansion joint for straight conduit run longer than 200 feet, weatherproof for outdoor installation with bonding jumper across each expansion fitting for ground continuity, Deflection fittings capable of accommodating not less than 3/4-inch displacement from normal condition in any direction including longitudinal (conduit centerline) direction; O-Z Gedney Type AX, DX, AXDX, EX, EXPB, PW, PBW, Crouse Hinds, or equal.

G. Insulated Grounding Type Bonding Bushings: In threaded metal conduits for terminations to motor control center, switchgear, panels, switchboard, power circuit pull boxes, junction and termination boxes; O-Z Gedney Type BLG for RMC and IMC, Type ABLG for ARC, Thomas and Betts or equal.

H. Insulating Bushings: for conduit terminations to lighting fixtures, pull boxes and junction boxes containing control wiring; O-Z Gedney Type A, Thomas and Betts or equal.

I. Flashing and Counter flashing: Threaded cast iron flash and counter-flash units with bushings if required to accommodate conduit size, Semco No. 1100-2 Series, J.R. Smith No. 1750 Series, or equal.

2.02 RIGID NON-METALLIC CONDUIT AND FITTINGS

A. Conduit: Materials those are resistant to moisture and corrosive agents; sufficiently strong to withstand abuse normal to its installation conditions; rigid PVC or equal.

B. Fittings and Conduit Bodies: NEMA FB 1.

2.03 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. EMT: ANSI C80.3 and UL 797; lightweight thinwall conduit, rigid steel, electro-galvanized and enameled on the inside; "X-Duct Jr.," "GE EMT," "Electrounit," or equal.

B. Fittings and Conduit Bodies: NEMA FB 1; steel, compression type. Set-screw or crimp-on type fittings are not acceptable.

C. EMT Connectors: Insulated throat type, Thomas and Betts, Appleton Electric Co. or equal,

2.04 FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS

A. Conduit: WW-C-566; steel; liquid-tight, interlocking single-strip type with overall molded jacket to exclude moisture; "Sealtite," Condu-Flex, or equal.

B. Fittings and Conduit Bodies: NEMA FB 1; steel; clamp or screw-in type.

C. Flexible Conduit Connectors: Thomas and Betts, Appleton Electric Co. or equal, galvanized steel with integral insulated throat.

2.05 PLASTIC CONDUIT AND FITTINGS

A. Conduit: NEMA TC 2

B. Fittings and Conduit Bodies: NEMA TC 3.

C. Acceptable Manufacturers:

1. Thomas & Betts, Carlton Industries, Inc., Seton Nameplate Co., D & G Sign and Label Co., or equal.

2. Substitutions shall be governed by the provisions of Section 01010.

PART 3: EXECUTION

3.01 CONDUIT SIZE, ARRANGEMENT, AND SUPPORT

A. Minimum conduit size:,

1. The minimum conduit size shall be 3/4 inch trade size in buildings or for exterior above ground installations.2. The minimum conduit size shall be 1 inch trade size for underground installations.

3. ½ inch EMT/FMC or 3/8 inch FMC permitted under certain conditions addressed elsewhere in these Specifications or as detailed on the Drawings.

B. Conduit systems shall be worked into complete, integrated arrangements, with like elements to present an orderly, neat, and workmanlike appearance as specified herein.

C. Install all conduit, raceways, junction boxes and device back boxes concealed, except as shown or noted otherwise. Conduits, raceways, junction boxes and device back boxes may be exposed in unfinished areas or in mechanical equipment rooms. Where conduits or raceways are exposed, above suspended ceilings, or under raised floors, they shall run parallel with walls or structural elements.

D. Vertical runs shall be plumb; horizontal runs level and parallel with structure, as appropriate. Groups shall be racked together neatly with both straight runs and bends parallel and uniformly spaced.

E. Install as high as practicable to maintain adequate headroom shown or required. Notify University before installation whenever headroom of less than seven feet - six inches will

result. Coordinate with work of other Divisions to achieve proper headroom as specified in this Division. In area above suspended ceilings, run conduits on wall surfaces wherever possible, instead of by hanging.

F. All conduits shall be securely fastened in place at intervals of not more than those required by the Code for the respective conduit type and size, with suitable clamps or fasteners of approved type, and all vertical conduits shall be properly supported to present a mechanically rigid and secure installation.

G. Maintain at least 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

H. No conduit shall be fastened to other conduits or pipes or installed so as to prevent the ready removal of other pipes for repairs.

I. Space conduit, supported directly from the concrete structure, out at least 1/4 inch using one-hole malleable straps with pipe spacers or, if three (3) or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of framing channel.

J. Individual conduits hung from roof structure shall be supported by split-ring hangers and wrought-iron hanger rods. Where three (3) or more conduits are suspended from the ceiling in parallel runs, use steel channels, Kindorf, Unistrut or equal, hung from 1/2-inch rods to support the conduits. The conduit on these channels shall be held in place with conduit clamps designed for the particular channel that is used.

K. Secure conduit racks to concrete walls and ceilings by means of cast-in-place anchors; die-cast, rustproof alloy expansion shields; or cast flush anchors. Wooden plugs, plastic inserts, or gunpowder driven inserts shall not be used as a base to secure conduit supports. Conduit shall be supported immediately on each side of a bend and not more that three (3) feet from an enclosure where a straight run of conduit ends.

L. Welding, brazing, or other heating of the conduit is not permitted.

M. Clearance: Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.

N. Conduits, 2 inch trade size or smaller O.D. but not larger than one-third concrete thickness, may be installed in structural concrete, between steel and bottom of slab, only where permitted by the Project Manager. Conduit may be in contact with reinforcing or other conduit where crossing at right angle, but maintaining minimum spacing of three times O.D. elsewhere.

O. The interior of all raceways shall be thoroughly clean and free form cement, paint, grease, plaster, and dirt.

P. Empty conduit in which wire is to be installed by others, including telephone and computer conduits, shall have pull lines installed. The pull line shall be 3/32 inch nylon or polyolefin having not less than 200 pound tensile strength. No less than 24 inch of slack shall be left at each end of the pull line. Attach a tag approved for the purpose to ends of pull line with nylon string and marked in indelible ink with location of other end and service for which conduit is provided.

Q. Fire Alarm System conduits and raceways, shall have all junction box covers painted red and labeled "FIRE ALARM" in white letters.

3.03 CONDUIT - INSTALLATION

A. Drawings indicate, generally, routes of all branch circuits. All runs to panels are indicated as starting from nearest outlet. Provide conduits to panels as though routes were indicated in their entirety.

B. Subcontractor shall not commence installation of conduits until all conduit runs have been accounted for and properly planned.

C. Conduits shall be continuous from panels to distributing centers, outlets or switches. Pull boxes and splice boxes shall be installed where shown and where otherwise required to facilitate installation of conductors and to comply with code requirements. Different types of conduits shall not be intermixed in any run.

D. Conduits shall be installed to be free of traps, where condensation water could accumulate.

E. When required for ease of cable pulling and as necessary to meet code, provide malleable conduit fittings or pull boxes even though not shown. Turns shall consist of malleable fittings or concentric bends.

F. Bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved one shot bender or conduit-bending machine. Make bends and offsets of as large a radius as construction will permit so as not to damage the conduit in any way. Conduit bends shall not be kinked and shall not be flattened more than 5% of the outside diameter of the conduit. Where exposed conduits are run in groups, all bends shall have a common center, with minimum inner radius eight times inside diameter of conduit. Standard elbows are not allowed at these locations.

G. The use of ½ inch EMT is permitted for the following.

1. Lighting switch legs where there are not more than six (6) conductors.2. EMCS/FMCS and other Class 2 or 3 control and signal wiring.

H. The use of flexible conduit is restricted. Flexible conduit is not permitted in walls, above inaccessible ceiling spaces or within other concealed or inaccessible spaces. A bare equipment grounding conductor shall be installed in all conduit runs having a length of flexible metallic conduit, liquid-tight flexible metal conduit, or non-metallic conduit as any part of the run. Liquid-tight flexible metal conduit shall be used in damp or wet locations requiring flexible conduit.

1. Flexible metal conduit or liquid-tight flexible metal conduit is permitted for final connection to transformers, rotating or vibrating equipment. The length of any size or type flexible conduit shall not exceed two (2) feet for this purpose.2. Above suspended ceilings, flexible metal conduit, 3/8 inch trade size minimum, is permitted for final connection from the above ceiling outlet box to the light fixture. Flexible metal conduit to light fixtures shall not exceed six (6) feet.

I. Plug or cap all unused conduit openings with a suitable device designed for the purpose. Caulking compound shall not be used for plugging conduit openings. Plug conduit with approved firestop material where conduits leave heated area and enter unheated area.

J. Provide escutcheon plates at exposed wall, ceiling, and floor conduit penetrations. Provide prime painted split escutcheons where exposed conduits enter walls, ceilings or floors in finished rooms. Use Crane Co. No. 10 BC, Grinnel, or equal.

K. Underground stub-ups shall use wrapped or PVC-coated rigid steel galvanized 90-degree elbows with a minimum radius not less than that permitted by Code or as noted on the Drawings and wrapped or PVC-coated rigid steel galvanized conduit riser.

L. Flash and counter flash all conduits through roof.

M. Penetrations (Where not cast-in place):

1. Pack space between conduit and hole in walls and floors with approved firestop materials for water and airtight seal. Refer to Section 07840 - Firestopping, for approved materials and methods of installation

2. Make penetrations through walls and floors watertight with approved firestop materials, even though concealed within walls or furred space.

3. Make penetrations through damp proofed/water proofed surfaces by appropriate means to maintain integrity of system penetrated, including penetrations caused by hangers suspended off such surfaces.

4. After the conduit is installed, the packed opening shall be painted to match the adjacent surface.

N. Penetrations through Concrete: Provide galvanized rigid steel nipples threaded both ends before concrete is poured. Each end of nipples shall extend three-inches beyond wall or floor surfaces.

1. Provide standard pipe caps on each end of each empty nipple.

2. Where conduit of smaller size than nipple or individual cables pass through nipples, pack annular space with fire-inert material, in accordance with Section 07840 - Firestopping, for a minimum depth of 2-inches each side or 3-inches on one side.

3. Where grout is noted provide Dry Wall Products, Inc. "Waterplug", U.S. Grout Corp., or equal, mixed and placed in accordance with manufacturer's instructions and 3-inches minimum depth.

O. Rigid Metal Conduit: Connect with threaded ends, threaded couplings, thread into integrally cast hubs or use double locknuts and insulating bushings. Threadless fittings are not acceptable.

P. Electrical Metallic Tubing: Connect with compression type connectors and couplings.

Q. Rigid steel conduit to EMT connection shall consist of EMT connector and threaded rigid conduit coupling.

R. Where rigid steel conduit is installed in concrete slab on grade provide 3-inch minimum thickness concrete encasement below conduit, tape wrap conduit with two layers of half-lapped 10-mil thick, black virgin vinyl polyethylene tape or factory-applied epoxy or PVC coating.

S. Keep conduits closed and moisture-tight during construction.

T. Conduit runs across roofs shall be supported [on redwood stand-off supports not less than six (6) inches nor more than eight (8) inches above the roof surface, and at intervals not greater than eight (8) feet. The supports shall be set in asphalt on tar roofs or other roofs where asphalt is a compatible agent, or shall be securely fastened to the roof with an appropriate roofing adhesive material on roofing materials where asphalt is not a compatible material.][as detailed on the Drawings.]

U. Conduit systems used for telephone/data system cabling shall not have more than a sum of 270-degree of bends between pull boxes, outlet boxes or termination closets. Condulet fittings shall not be used in such conduit systems.

V. No conduit shall be installed exposed on floor in any areas except when approved by the project design engineer or inspector.

3.04 GROUNDING

A. Permanently and effectively ground all conduit systems in accordance with Section 16450. All grounding type bushing shall be grounded with the equipment ground wire.

B. A separate ground conductor shall be run in each conduit and shall be connected to each junction box using a grounding screw in each box. An equipment bonding jumper shall be used to connect all grounding type receptacles to the grounded box. The use of looped wires under grounding screws shall not be permitted.

END OF SECTION 16110