

CONDUIT SYSTEM, CABLE TRAY, CABLE LADDER AND TRUNKING INSTALLATION**PART 1 – GENERAL****1.1 WORK DESCRIPTION**

- A. This section describes the supply and installation of wiring facilities systems include conduits, cable trays, cable ladder and Trunking system, c/w associated fittings and accessories.
- B. All cables run above the suspended false ceiling, concealed in walls, columns, or on surface shall be supported by conduits, cable tray and Trunking or cable ladder system. No free slinging cable is allowed.
- C. The cable routes as shown in the drawings shall be used as a guide only. Prior to the installation, the cable routes shall be coordinated with other services. Uncoordinated and inaccessible routes after other services are installed, shall be relocated at the expense of the Contractor.
- D. All conduits, trunking, cable trays and cable ladders shall be earthed in accordance to IS: 4043.

1.02 STANDARDS

- A. The complete wiring facilities system shall be manufactured, supplied, installed and tested in accordance with the latest revision of the India-Delhi standards and the appropriate BS/IEC include:
 - 1. Steel Conduit and Fitting Accessories IS:9537 (Part-II)/ BS4568 & BS731
 - 2. PVC Conduit and Fitting Accessories IS-9537/1983 (Part-III)/BS6099 & BS4607
 - 3. Cable Tray BS729
 - 4. Cable Ladder BS729
 - 5. Cable Trunking BS4678
- B. The complete wiring facilities system shall also conform to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this Specification and Drawings, whichever is the more stringent and acceptable to the Engineer.
- C. In the adoption of standards and requirements, the Contractor shall take the following precedence:
 - 1. Engineer's decision;
 - 2. Local codes of practice;
 - 3. Drawings;
 - 4. Specification;
 - 5. International standards and requirements

1.03 SUBMISSIONS

- A. All technical submissions shall be approved by the Engineer prior to the respective stages of construction.
 Routing of installation
 Sample with proprietary factory-made accessories, elbows, risers, reducers, tees, crosses, etc.

PART 2 – PRODUCTS

2.01 STEEL CONDUIT AND ACCESSORIES

A. Steel Conduit

1. All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this.
2. Both inner and outer surfaces shall be smooth without burrs, dents and kinks.
3. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout.
4. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle.
5. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded.
6. The minimum size of the conduit shall be 19/20mm dia.
7. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

B. Fittings

1. Samples of conduit fittings shall be submitted for approval prior to installation.
2. Fittings shall be those intended for use with screwed conduits and shall comply with IS 9537. However, bends, elbows and tees shall not be installed.
3. Boxes and cover plates that are installed outdoors shall have fixing lugs exterior to the box so that fixing screws do not enter the box interior.
4. Adaptors used with flexible conduits shall conform to IS: 9537.

C. Circular Boxes

1. Circular boxes shall be of malleable cast iron, galvanized and of standard pattern with spout(s). When used for connecting lengths of conduits, circular boxes shall be provided with cover plates of similar make that are complete with brass fixing screws.

D. Rectangular Boxes

1. Rectangular boxes (adaptable boxes) shall be of mild steel not less than 2.4 mm gauge and galvanized. When used as junction boxes, lids of the same gauge with brass fixing screws shall be used.

E. Boxes for Accessories

1. Boxes for accessories shall be suitable for surface mounting or recessed mounting according to the requirements. Surface mounted boxes and accessories shall be metal clad pattern. Recessed boxes and accessories shall be complete with insulated moulded type cover plates conforming to IS: 5133 Part I-1969.

F. Covers

1. All covers for boxes, etc shall be made of galvanized steel of 1.2 mm thickness.

2.02 PVC CONDUIT AND ACCESSORIES

A. PVC Conduit

1. All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-9537/1983 (Part-III).
2. All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces.
3. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned.
4. Conduit shall be terminated with adopter/PVC glands as required.

B. PVC Conduit Accessories

1. Accessories used for conduit wiring shall be of an approved type complying to IS: 3837-1966.
2. All accessories used shall be of standard white or black color, identical to conduit used.
3. Plain conduits should be jointed by slip type of couplers with manufacturer's standard sealing cement.
4. All conduit entries to outlet boxes, Trunking and switchgear are to be made with adaptors female thread and male bushes screwed.
5. PVC-switch and socket boxes with round knockouts are to be used. The colors of these boxes and the conduits shall be the same.
6. Standard PVC circular junction boxes are to be used with conduits for intersection, Tee-junction, angle-junction and terminal. For the drawing-in of cables, standard circular through boxes shall be used.
7. Samples of accessories shall be submitted for approval prior to installation.
8. All jointing of PVC conduits shall be by means of adhesive jointing. Adequate expansion joints shall be allowed to take up the expansion of PVC conduits.

2.03 CONDUIT INSTALLATION

A. Layout

1. The conduit layout and conduit routes shall be submitted for approval. Allowance for adjustments due to site conditions shall be provided with no extra cost.
2. Conduit routes shall be chosen for easy, straight runs with a minimum of bends and crossings. Generally they shall follow the structure of building, running at right angles or in parallel to floors and ceilings. Conduits shall be kept within 300 mm of floors and ceilings when running parallel to them.
3. Outlet boxes for housing accessories shall be used as draw boxes. The total number of draw boxes shall be kept to a minimum and shall be provided so that conduit runs do not exceed 12 m or have more than two right angle bends.
4. All conduits shall be kept clear of gas and water pipes. In particular, conduits shall be at least 150 mm away from gas pipes. Where proximity to these pipes is unavoidable, they shall be effectually segregated e.g. using rubber or other insulating material to prevent appreciable voltage differences at possible points of contact. Segregation from extra low voltage circuits and telecommunication circuits shall also apply unless these are wired to the same voltage requirements as lighting and power circuits.
5. Conduits from different distribution boards shall not be connected to the same junction box. Each run of conduit shall be assembled complete with draw-in-wires.

B. Joints And Terminations

1. Electrical and mechanical continuity shall be maintained throughout all conduit joints and terminations. Conduit threads shall be thoroughly cleaned and the conduits tightly screwed. The conduit system shall be watertight after installation.
2. Conduits shall be connected using couples or via boxes. With a coupler, the ends of the conduit shall butted close together and the running coupler is screwed tightly on and tightened by a locknut.
3. Conduits terminating into boxes provided with spouts shall be threaded so that there are no exposed threads. For boxes with no spouts, the termination shall be made using a brass bush and a coupler. The conduit is pushed through the knockout or drilled entry and the bush is screwed tightly onto its end. The coupler is screwed to butt firmly against the exterior wall of the box.
4. Where conduits are not jointed or terminated in boxes, they shall be terminated in a screwed brass bush.
5. In all joints and terminations, conduit threads shall not be exposed. Where this cannot be avoided as in a running coupler, the exposed threads shall be coated with red lead paint to seal against the ingress of water.

C. Bends

1. Conduits shall only be bent cold with an approved type of bending block or bending machine, without altering the dimensions of their sections.

2. All conduit bends shall be such as to permit compliance to the requirements for bends in cables to as stated in the BS 7671.
 3. Bends shall be made with as large a radius as the position of the conduit within the building permits. Where the bend is more than 90 degree, circular or rectangular junction boxes are to be used for connecting conduits.
- D. Cabling
1. The conduit system must be completely installed and free of obstructions and sharp corners before any cables are drawn in. Conduits shall be thoroughly swabbed to remove moisture and dirt immediately prior to the drawing in of cables.
 2. Cables shall be drawn without crossing each other and shall not be pulled against the walls of the draw boxes. Slack cables shall left in all draw boxes.
 3. Cables shall be continuous throughout conduit lengths and no joints are permitted. There shall be no kink in cables, neither any cut, abrasion or chink in the cable insulation.
 4. The same conduit shall carry the lead and return conductors bunched together. However, the same conduit shall not house cables from different distribution boards.
 5. Cables for power and lighting circuits and extra low voltage systems shall not be drawn into the same conduit. Lighting and power final circuits shall be run in separate conduits except, where an adaptable box is employed as final distribution point, a number of final circuits may be grouped together in larger conduits between the distribution board and the adaptable box provided that all final circuits in one conduit are of the same phase. In the case of three phase circuits, all three phases including neutral, if any, shall be drawn into the same conduit.
 6. Conduits shall not constitute the earth continuity path for the electrical circuit. A separate circuit protective conductor shall be installed within the conduit. The whole conduit system shall be effectively earthed.
 7. Flexible conduits shall also have a separate earthing conductor installed within the tubing and connected at conduit ends. Flexible conduits in general shall not be used for more than 3m length.
 8. Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS:694-1990

| Nominal | 20mm | | 25mm | | 32mm | | 38mm | | 51mm | | 64mm | |
|--|------|---|------|---|------|----|------|---|------|----|------|----|
| Cross-Sectional area of Conductor in Sq.mm | | | | | | | | | | | | |
| | S | B | S | B | S | B | S | B | S | B | S | B |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1.50 | 5 | 4 | 10 | 8 | 18 | 12 | - | - | - | - | - | - |
| 2.50 | 5 | 3 | 8 | 6 | 12 | 10 | - | - | - | - | - | - |
| 4 | 3 | 2 | 6 | 5 | 10 | 8 | - | - | - | - | - | - |
| 6 | 2 | - | 5 | 4 | 8 | 7 | - | - | - | - | - | - |
| 10 | 2 | - | 4 | 3 | 6 | 5 | 8 | 6 | - | - | - | - |
| 16 | - | - | 2 | 2 | 3 | 3 | 5 | 5 | 10 | 7 | 12 | 8 |
| 25 | - | - | - | - | 3 | 2 | 5 | 3 | 8 | 6 | 9 | 7 |
| 35 | - | - | - | - | - | - | 3 | 2 | 6 | 5 | 8 | 6 |
| 50 | - | - | - | - | - | - | - | - | 5 | 3 | 6 | 5 |
| 70 | - | - | - | - | - | - | - | - | 4 | 3 | 5 | 4 |

Note:

- i. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
- ii. The columns heads 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The

columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

iii. Conduit sizes are the nominal external diameters.

E. Access And Drainage

1. The conduit system shall be rewirable, that is, draw boxes must be accessible for the purpose. Where boxes are concealed, their covers shall be flushed with the finished surface.
2. The need for accessibility notwithstanding, the conduit system shall be protected against the ingress of water and impurities. When installed, conduits shall be kept dry and free of debris with approved pipe plugs or caps. Such plugging is especially essential prior to pouring concrete for concealed installation. As for boxes, they shall be covered by steel plates prior to concreting.
3. When installed outdoor, and in situations liable to condensation of moisture, conduits shall be arranged to be self draining, so that water may drain to low points which are fitted with a drain plug. Conduits laid under concrete floors shall have watertight floor-traps of approved detail for access of these drainage points.
4. Conduits run on surfaces other than structural steel members shall be secured using galvanized space bar saddles and brass fixing screws. Spacing of saddles shall not exceed 1.2 m for conduit sizes up to and including 25 mm and 1.8 m for sizes 32 mm and above.
5. Conduits run on structural steel shall be secured using girder clips or an approved clamp. These conduits and those run in the vicinity of structural steel shall be bonded to the steelwork using an efficient and permanent metallic connection. The conduits shall not in any way be under mechanical stress.
6. All conduit boxes except loop-in patterns shall be fixed direct to the building structure in addition to the support provided by the conduits.
7. Conduits terminating into surface boxes shall be secured by a minimum of 3 saddles at not less than 32 mm, 150 mm and 300 mm respectively from the box.
8. Conduits shall be painted with an approved paint to blend with visual environment. A zinc rich undercoat shall be provided before painting the final coat.

2.04 CABLE TRAY

- A. Cable tray shall be of perforated type and constructed a minimum 2.0 mm hot dipped galvanized mild steel for outdoor damp condition, and epoxy coated electro-galvanized mild steel for indoor installation. All cable trays shall be installed in a straight run parallel to walls where possible.
- B. Cable trays shall be supported by electro-galvanized 'U' channel with galvanized threaded rod for indoor suspended tray and hot-dipped galvanized for area subject to weather.
- C. All hangers shall be installed at 1 metre intervals and shall be primed and painted to match with the surrounding building finish approved by the Engineer.
- D. For cable tray that are exposed to the weather, a hot-dip galvanized covers of 1.5mm gauge steel, flush fixing type with gasket, shall be installed on top of the tray.
- E. Depending on the size of cable trays spare space of 25% shall be maintained for future expansion.
- F. Copper earth link bar shall be fixed at every joint of the cable tray run.

2.05 CABLE LADDER

- A. All cable ladders and accessories installed indoors shall be heavy-duty epoxy coated electro-galvanized mild steel type. All cable ladders installed outdoors shall be heavy-duty hot dipped galvanized hot rolled mild steel. Thickness of the mild steel shall not be less than 2 mm.
- B. Cable ladder shall have a 150 mm high longitudinal side member for ladders width of 800 mm or above and 120 mm high longitudinal side member for ladder width less than 800 mm.

- C. The rugs shall be at least 50 mm wide, with slots of 25 mm x 10 mm at 25 mm intervals covering the length of the rungs. The rungs shall be spaced at 300 mm apart along straight lengths of the ladder.
- D. All nuts, bolts and washers for clips and brackets shall be zinc plated. Each cable ladder shall be in standard manufacturer's length and supplied complete with coupling sets consisting of fishplates, spined bolts, nuts and locking washers.
- E. The complete cable ladder installation shall be provided with all necessary proprietary factory-made elbows, risers, reducers, tees, crosses, drop-outs, etc. and any site fabricated items will not be permitted.
- F. Separate flexible earth continuity connectors of at least 16mm² copper jumpers shall be installed between the ladder sections.
- G. All cables ladders shall be supported from the ceiling concrete slab, steel structures or sidewalls using a frame system, with overhead hangers, support channels, hanger rods or angle brackets, beam clamps and ceiling brackets.
- H. Fixings and supports shall be installed at regular intervals not exceeding 1000 mm and 150 mm from all bends, tees, inter-sections and risers.
- I. When cable ladder is required to install across structure expansion joints, the ladder shall be in two sections between supports installed on either side of the expansion joint.
- J. The ladder sections shall then be jointed with expansion joint fishplates, bolts, nuts and washers installed in elongated holes permitting a lengthwise movement of 25 mm from the initial fastening position.
- K. For cable ladder that are exposed to the weather, a hot-dip galvanized covers of 1.5mm gauge steel, flush fixing type with gasket, shall be installed on top of the ladder.
- L. Copper earth link bar shall be fixed at every joint of the cable ladder run.

2.06 CABLES TRUNKING

- A. Cable trunking shall be manufactured from 1.6 mm minimum electro-galvanized mild sheet steel to BS4678 finished in oven-baked electrostatically coated epoxy power coating with color to the Engineer's choice.
- B. All trunking shall have removable lids extending over their entire lengths. Lids shall be fixed at interval not exceeding 1 metre by means of brass steel screws which are protected against corrosion by a finish of zinc coating or equivalent to zinc coating.
- C. Factory-made bends, joints, elbow, riser, tee, reducer and accessories with same material shall be provided throughout the installation for trunking.
- D. Trunking space factor shall be in compliance with latest IS standards.
- E. Copper earth link bar shall be fixed at every joint of the cable trunking run.

Note: All items mentioned in this section shall be manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA)

END OF SECTION