

DESIGN CRITERIA AND STANDARDS

Electrical DCS
Electrical Construction

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1 Introduction

- a) This document is the Design Criteria and Standard for the Electrical Construction of all Electrical Equipment and systems.
- b) This document shall be always applied together with Electrical DCS Electrical General Requirements.

2 Installation Materials

- a) The installation materials shall be according to local standards, of long life, and reliable quality.
- b) Connection boxes have be made of plastic material.
- c) Cabling has to be done by cables, not by tubes and wires!
- d) Smaller distribution panels up to 400 A shall be designed as plastic boxes with transparent covers.
- e) All spare parts shall be available locally.
- f) The Contractor shall provide examples of foreseen materials.

3 Cabling

3.1 Cable Installation

- a) Cable installation on cable ladders, cable trays is preferred.
- b) The installation shall be arranged so that power and signal cables on cable ladders are separated.
- c) The cables shall be directly laid to the corresponding consumers; utilization of junction boxes shall be avoided. Differing designs have to be discussed and agreed upon by the Employer.
- d) Only signals belonging to the same object shall be collected in a junction box. The housing of the local disconnect switch may be used for this purpose.
- e) All cables shall be marked on both ends with the Employer's cable identification system.
- f) Any holes for cables through walls of buildings or ducts shall be closed and sealed fireproof on completion.
- g) Cable tunnels are not allowed. If the design or plant layout requests this kind of installation method explicit approval has to be given by the Employer.

3.2 Cable Ladders

- a) Cable trays, cable ladders are preferred in order to increase flexibility for installations.
- b) Cable ladder constructions, supports etc., shall be of galvanized steel.
- c) Cable ladder and vertical cable ladders shall be designed with a minimum 20 % spare capacity to add new cables later on.

- d) Single cables directly routed to one device shall be laid in cable protection conduits. These conduits need not to be closed completely but they shall protect properly against any mechanical damage and supply sufficient support. Open bends are allowed. Sharp-edged openings shall be covered with glands to avoid cable damages. The conduits shall prevent accumulation of condensed moisture and the ingress of water in any part of the installation.
- e) Individual design for each location and environmental conditions shall be considered.
- f) In electrical cabinets, power and signal cables shall be installed in different sections.
- g) Inside of production buildings cables shall be laid on overhead ladders or vertical cable ladders. The build-up of dust and other materials on horizontal arranged cable ladders shall be prevented.
- h) Instrumentation and communication cables (instrumentation, process control, communication, signals) shall be installed on a separate cable tray, vertical ladders or conduits with a minimum distance to power cables of 300 mm.
- i) Any cables for digital signals exceeding 24 VDC shall be classified as power cables and shall be segregated accordingly.
- j) Two across disposed fasteners shall fix cables on vertical ladders at the ladder bars.
- k) All vertical cable ladders shall be protected against mechanical damage at least up to 1 m above floor level unless further protection is not required for special reasons.
- l) Welding of supports and cable trays or cable ladders to galvanized steel structures is not allowed. Clamp and bolt connections shall be used..

3.3 Cable laid directly in ground

- a) Power cables may be laid directly in ground.
- b) The minimum depth of the cable trench shall be 1 m below finish grade.
- c) Cables shall be protected by a sand bed underneath and marked (ribbons or tape) through the entire route.
- d)
- e) All cables must be suitable to be laid in ground.

4 Start-up warning

- a) Visual and acoustic start-up warnings are required
- b) The control logic for the start-up warning shall be part of the Process Control System.
- c) The power section of the start-up warning circuit is located in the in-feed section of the MCC.
- d) For plants that are spread over a larger area it is necessary to install several start-up warning circuits. The layout shall be discussed and agreed upon by the Employer.

5 Process Instrumentation

- a) Any damages by temperature, weather conditions or from leakages of hot production materials have to be avoided.

- b) Piping of pressure measurements shall be done to prevent blockages, leakage and allow for easy maintenance access.
- c) Pressure transmitters shall be connected to the process with a T- connector. The horizontal connector shall be closed with a plug that can be removed for puncturing with a stick to remove any build ups or clogging. The pressure transducer shall be installed at the vertical, upward directed part.
- d) Shut off valves and compressed air supply for cleaning shall be installed at critical areas.
- e) All piping for gas extraction shall be routed with a slope, so that condensed water will flow down and sample at the lowest point.
- f) Two shut off valves shall be installed: One valve to release the water. One valve to shut off the pressure measurement while cleaning the piping with pressed air.



Photo 1: Shows the installation of pressure transducers with valve for shut off and cleaning



Photo 2: Shows a typical installation of a pressure measurement at the kiln hood



Photo 3: Shows a typical installation of a temperature measurement in the pre-heater



Photo 4: Shows a typical installation of a temperature measurement in the pre-heater

6 Cable Routing Components

a) The entire cable installation shall be done with use of following components:

1. cable ladders
2. mesh wire cable trays
3. steel conduits

b) To ensure high durability of the installation, all components shall be made of galvanized steel.

6.1 Cable ladders

a) Standardized width of cable ladders, for instance 200, 400, 600mm, shall be used according to needs.

b) The selected cable size shall consider 20% of free room for future cable installation.

c) Ladder height of 100mm shall be selected to allow multilayer cabling.

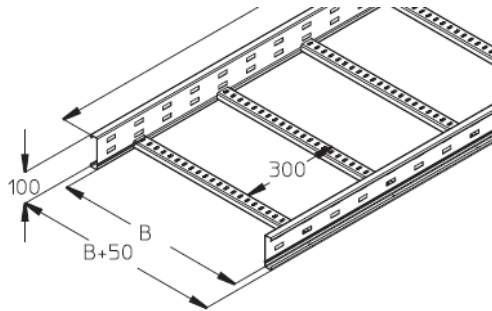


Figure 1

6.2 Mesh wire trays

- Mesh wire is a very good alternative to standard cable ladders and provides more flexibility. Moreover it reduces the risk of dust build-ups to a minimum. It is highly recommended to use this type of cable trays whenever possible and economically.
- Selected size of the Mesh wire tray shall ensure multilayer cabling (height) and have 20% provision for future expansion (width).
- Only heavy duty mesh wire trays with a mesh diameter of >4 mm may be used.
- Perforated cable trays shall be avoided due to the possibility of high dust settlements



Figure 2

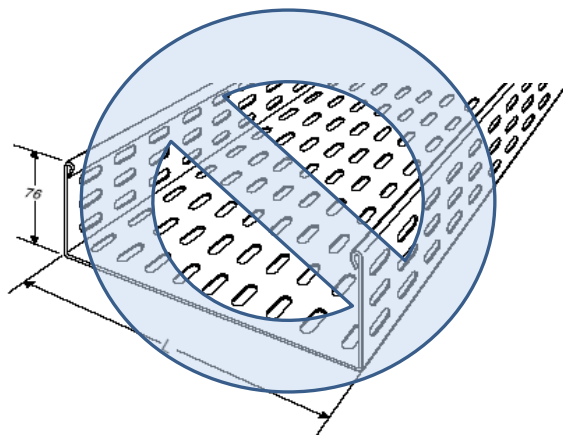


Figure 3: Perforated cable trays shall not be used

6.3 Steel conduits

- a) Steel conduits shall be generally used as end stage of cable installation, leading cable to particular field device, like motors, instruments, lighting fixtures etc. They can also be used as a replacement of cable ladder, when only a few cables shall be installed (e.g. pull cord switch cable along belt conveyor). Steel conduits may be replaced by small width (50 or 100mm) mesh wire conduits.
- b) Steel conduits are not permitted to be used for installation of single wires inside because of insulation problems.

7 Cable Installation

7.1 Cable route arrangement

In cement plants with a dusty atmosphere cable installation shall be designed to avoid dust build ups. Cable ladders shall be installed vertically whenever possible, to minimize cement and dust settlement.



Photo 5: Vertical Cable routing



Photo 6: Horizontal Cable routing

7.2 Fitting accessories

- a) Galvanized cable ladders and steel conduits shall not be welded, as it damages the coating which exposes protected items to corrosion. Therefore installation shall be done by using the original fitting accessories recommended by manufacturer.
- b) Materials shall be of strong and reliable quality to withstand weight, rain, temperature and wind conditions.



Photo 7



Photo 8



Photo 9

7.3 Bending, cornering, branching

- a) Cutting, shaping and welding of straight components to transform them into elbows, raisers etc, is not allowed.
- b) No field fabrication of items like elbows, reductions, raisers permitted. These items shall be purchased components from the cable tray supplier.

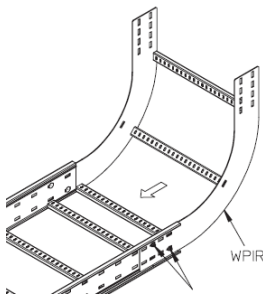


Figure 4

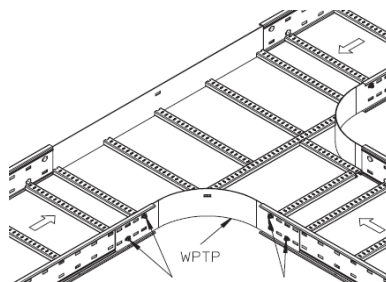


Figure 5

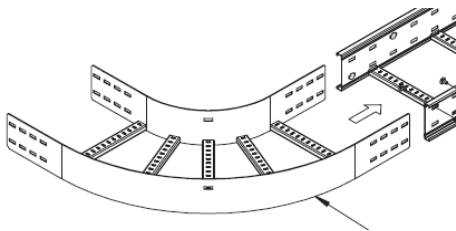


Figure 6

Cable Tray Examples



Photo 10: Cable Tray Horizontal bend



Photo 11: Vertical bend



Photo 12

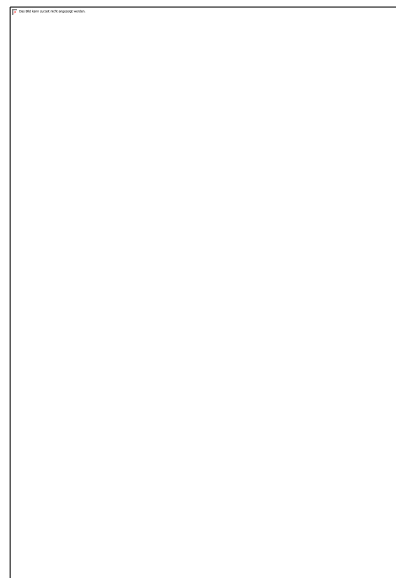


Photo 13

- c) Bending of galvanized steel tubes shall be avoided as it damages protective coating. The tubes shall be left open which allows dust and water to escape from the tube.



Photo 14: End Caps

- d) Ends of steel tubes shall be equipped with caps preventing cable damage

7.4 Cable alignment

- a) Despite it has no influence on functioning of cable installation, the aesthetic aspect shall be also considered while doing cable installation.
- b) Cables shall be laid parallel without crossing each other.



Photo 15: Parallel Cable Installation

- c) Power cables shall be either separated from control cables while on the same ladder, or placed on another ladder, if there is no room for both. 20% of room shall be kept free for future installation expansion.



Photo 16



Photo 17



Photo 18

- d) In order to reduce cable ladders quantity as well as space required for electrical installation, it is recommended to lay the cables in layers (on top of each other). Proper heat exchange shall be ensured therefore, power cables shall be laid in max 3 layers. There is no limitation for number of layers in case of control cables.

7.5 Cable fastening

- a) To achieve durable installation, cables shall be fixed to the ladder by means of original steel clamps.



Photo 19

- b) Plastic cable ties are acceptable if they are of heavy duty and UV proof type. In case of Cable Ties, cross disposed arrangement is preferred.

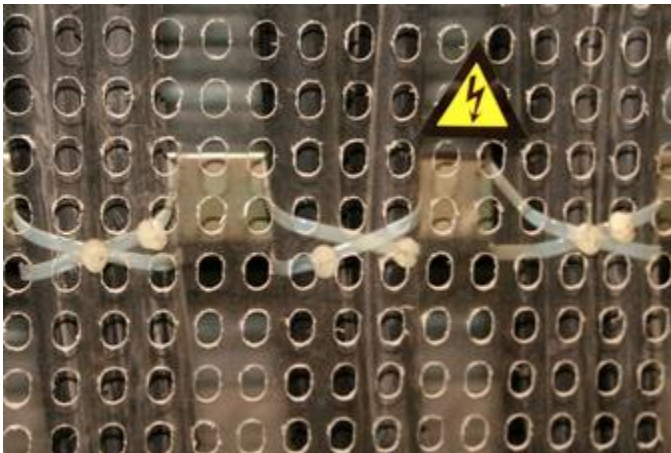


Photo 20

- c) In case of small outer diameter, cables can be fastened in bunch, while for bigger diameter, they shall be treated separately.



Photo 21:

8 Local devices

8.1 Field devices

- a) Field devices like motors, instruments etc. cables shall have some reserve foreseen for possible cable break caused by frequent disconnection/dismantling. Therefore a loop shall be made on the cable before entering the device terminal compartment.
- b) Small field devices may be connected with plug and pin jack.



Photo 22: Cable loop



Photo 23: Cable loop



Photo 24: Cable loop



Photo 25: Cable loop is not required on large diameter cable.



Photo 26: All cables shall be equipped with labels at both ends

8.2 Terminal boxes

- a) Terminal boxes are only allowed for instruments delivered with cable like proximity switches or motion detectors.
- b) Terminal boxes in general must be avoided, however to simplify the installation terminal boxes are permitted.



Photo 27



Photo 28

8.3 Local Switches

- a) Local switches serve as electrical isolation and command units in local operation mode.
- b) They also collect respective machine related digital signals like motion detector, pull cord switches, level switches etc. Local switches shall be installed nearby the motor of a particular machine.
- c) Walls, steel structure or free standing supports can be used to install the Local Switch Boxes.



Photo 29



Photo 30



Photo 31



Photo 32

- d) Cables entering local switches or devices from floor level shall be properly protected against damage. This can be achieved by steel tubes or metal covers installed on the cable ladder.



Photo 33

8.4 Pushbuttons and other devices

All junction boxes, pushbuttons, receptacles, shall have cable entry from the bottom. Top connection is not allowed due to possible dust and water entry.



Photo 34



Photo 35

9 Non Process Buildings

9.1 Workshop Installations

- a) All maintenance and workshop power outlets (230 V and 400 V) shall be IP 44 or better.
- b) A layout showing the position of all machines and working areas for portable tools is required. Sufficient power outlets for all kind of hand held and portable tools have to be installed.

9.2 Laboratory Installation

- a) White, 120 mm wide plastic channels shall be used for all 230 V, 400 V sockets and for IT and telephone connections.
- b) The installation shall be horizontal in a common high below the windows and above the laboratory tables.

9.3 Office Work Place Installation

- a) White, 150 mm wide plastic channels shall be used for all 230 V sockets and for IT and telephone connections.
- b) The installation shall be vertical from the bottom or horizontal in a common high below the windows and above desks.



Photo 36: Cable routing in Lab



Photo 37: Cable routing in Offices