



Technical Standard

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Mondi AG.

Mondi Standard Harmonization

EARTHING AND LIGHTNING PROTECTION

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ABBREVIATIONS

AC	Alternative Current
ANSI/ISA	American National Standards Institute / International Society of Automation
ATEX	ATmosphères EXplosibles, explosive atmospheres
CE	Conformité Européenne, European conformity
CENELEC	European Committee for Electrotechnical Standardization
DIN	Deutsches Institut für Normung, German Institute for Standardization
dwg	AutoCAD format
EB	Equipotential bonding bars
e.g.	exempli gratia, for example
EC	European Commission
EIA	Electrical, Instrumentation and Automation
EMC	Electromagnetic Compatibility
EN	European Standard
etc.	et cetera, and other similar things
EU	European Union
EU-MEPS	European Minimum Energy Performance Standard
Ex-area	Explosive area
FE	Functional Earth
HV	High Voltage
i.e.	id est, that is
IEC	International Electrotechnical Commission
IP	Ingress Protection
ISO	International Organization for Standardization
LED	Light-Emitting Diode
LV	Low Voltage
MCC	Motor Control Center
MCS	Machine Control System
MEB	Main equipotential bonding bars
MV	Medium Voltage
PE	Protective Earth
PED	Pressure Equipment Directive

PWM	Pulse Width Modulation
SWG	Switchgear
TN-S	Terra Neutral Separate
UPS	Uninterruptible Power Supply
VAC	Volts Alternative Current
VDC	Volts Direct Current
VFD	Variable-Frequency Drive
VSD	Variable Speed Drive

1 GENERAL

The purpose of this standard is to specify to the Machine Supplier, Engineering Company, Electrical Supplier and Electrical Installation Contractor the general principles of earthing. Deviations from these instructions are permitted only by separate agreement.

2 NORMS AND STANDARDS

2.1 General

The installation and equipment must comply with the requirements of current local laws, regulations and safety instructions.

The installation and equipment shall comply with the Project Electric, Automation and Instrumentation Standards.

The electrical equipment shall conform to applicable IEC standards. Any deviations shall be mentioned in the tender.

The Supplier shall carry out any modifications requested by authorities, free of charge.

The equipment shall fulfil the requirements of the PED (Pressure Equipment Directive (2014/68/EU)).

The equipment which is installed to ATEX area shall fulfil the requirements of the standard IEC 60079-14:2013 (Explosive atmospheres - Part 14: Electrical installations design, selection and erection).

2.2 Codes and Regulations

The equipment and installation shall comply with the following standards, regulations and instructions:

- Local authorities' regulations and recommendations
- Laws and regulations currently in force in the current country, especially:

- 250/2021 Sb. „Zákon o bezpečnosti práce v souvislosti s provozem vyhrazeným technických zařízení a o změně souvisejících zákonů“
- NV 190/2022 Sb. „Nařízení vlády o vyhrazených technických elektrických zařízeních a požadavcích na zajištění jejich bezpečnosti“
- NV 194/2022 Sb. „Nařízení vlády o požadavcích na odbornou způsobilost k výkonu činnosti na elektrických zařízeních a na odbornou způsobilost v elektrotechnice“
- EU norms and directives (Machine, PED, EMC, Low Voltage, ATEX, etc.)
- Project instructions
- Mondí standards
- Mill instructions
- IEC recommendations
- Mondí OT Security Policy

Mondí standards:

- MG0001 General Mill Specifications Summary
- MEIA0001 Electrical, Automation and Instrumentation Instructions for Equipment and Machinery Suppliers
- MEIA0002 Recommended Manufacturers for Electrical and Instrument Equipment
- MEIA0003 Design Criteria For Instrumentation and Automation
- MEIA0004 Electrical Design Criteria
- MEIA0005 Cable standard
- MEIA0006 Implementation Procedure for Safety Related Systems (SRS)
- MEIA0007 Instrument and Automation Installation Standard
- MEIA0008 Electrical Installation Standard
- MEIA0009 Implementation Procedure for Control Systems (DCS, MCS) and FAT
- MEIA0010 Implementation Procedure for Quality Systems (QCS, Web Break System, Web Inspection System, Vibration Monitoring System)
- MEIA0011 Control Systems Process Interfacing Standard
- MEIA0012 DCS and MCS programming standard
- MEIA0013 Earthing and Lightning Protection Standard
- MEIA0014 Building Electrification and Lighting
- MEIA0015 Operational Technology Information and Communication Technology (ICT) standard
- MEIA0016 Implementation Procedure for electrification, automation and instrumentation checkouts and cold commissioning
- MM0002 Piping Standard (Process connections for instrumentation)

2 EARTHING SYSTEM

Earthing system shall fulfil the condition of the global earthing system specifications (IEC 61936-1). Global earthing system consists of:

- Earthing electrodes and earthing conductors
- Earthing /equipotential bars
- Protective conductors and protective bonding conductors
- Lightning protective conductors and lightning ground electrodes

All these items together will ensure that there are no dangerous touch voltages.

All equipment required to be earthed by the Inspection Authority shall be earthed, whether specifically mentioned in the drawings or not.

All earth conductors above earth shall be so located as to be readily visible for inspection.

TN-S system neutral (N) and protective earth (PE) shall not be connected together at any part of the distribution system other than at the main distribution centre.

All electrical equipment located at electrical rooms will be connected to earthing bars with adequate size yellow green copper cable for potential equalizing.

Field equipment potential equalizing earthing cables will be connected to earthing bars or directly to the main earthing cable.

All earth connections shall be made only after the surface has been thoroughly cleaned of paint and dirt. Earth wires shall not run parallel to single core cables.

The earthing system principles are shown in appendix 1

3 EARTHING ELECTRODE

Earth electrode consists of 70 mm² cu or bare Fe/Zn flat bar iron (5x40 mm), which is installed around the building underneath building foundation at about 1 m depth. Supplementary connecting ropes across the building will be installed at about 80 m intervals. Piling reinforcement steel or 70 mm² cu will be connected to earth electrode at about every second or third column. Pigtails for earthing cable connection will be taken up at about every third outside wall building column and one in a transformer room and one or two in cable room on the ground floor. Pigtails for earthing cable connection will be taken up also a few places inside the building.

The earthing electrode shall be pulled-up above floor level into MEB, located in transformer bay, main electrical room/cable room,. In addition the earthing electrode shall be connected to building steel frame columns in convenient intervals (approximately every 3rd column around building or according the main process supplier specification).

Reinforcement steels of foundation will be connected to the earthing electrode at least at the same column where the electrode has been taken up above the floor level. Connection will be made under ground by using rounding steel bar (10 mm stainless steel) which will be welded to reinforcement steels and connected to the earthing electrode.

It is recommended that the earthing electrodes of the different buildings will be connected together by bare 70 mm² Cu conductor laid in ground.

The joints of the main under earth earthing electrode (to foundation re-bars etc.) or earthing loop (around the building) shall be of Compression type joints.

4 EQUIPOTENTIAL BONDING

4.1 Equipotential Bonding Bars

The bare copper main equipotential bonding bars (MEB-bars), shall be installed in each place where the building earthing electrode has been taken up above the floor level, e.g. in electrical room or associated cable room. Earthing electrode will be connected to these bars. Additionally more bars (EB-bars) shall be installed in the transformer rooms, rack rooms, auxiliary rooms and process area, close to equipment that needs equipotential bonding. EB-bars have to be “tin-coated”. Earth bars will be installed as shown in the material lists and drawings.

All exposed- and extraneous conductive parts in buildings which have to be earthed shall be connected to these EB-bars. The size of each bar is depending on a number of connected conductors. See appendix 1.

4.2 Equipotential Bonding Network

The equipotential bonding network inside a building consists of EB-bars which will be interconnected to MEB by using main equipotential bonding conductors (120 mm² Cu ye/gr). These bonding conductors will be installed in grid form on main cable routes in each building.

Every building has its own equipotential network and they all will be connected together (MEB to MEB) by main equipotential bonding conductors (120 mm² Cu ye/gr). These bonding conductors will be installed on cable trays running in pipe-bridges between the buildings.

Process towers/ tanks in the outside of buildings shall be connected to the earthing electrode. Purpose of these connections is lightning protection and also potential equalizing.

4.3 Equipotential Bonding Conductors

All simultaneously accessible exposed conductive parts and extraneous conductive parts (where needed) shall be earthed with equipotential bonding conductors direct to the nearest MEB/EB-bar of the main equipotential-network. Typical items which are connected to equipotential network are:

- PE-bars of SWGs and MCCs
- Metal parts of electrical rooms
- Cable trays
- Pipes and tanks
- Metal structures
- Exposed conductive parts
- Control cabinets/boxes on field

4.3.1 Cable Trays

The Cable trays will be connected at suitable intervals (15 m inside building, 30 m outside ex. pipe bridges) to the nearest EB-bars (or to main equipotential bonding conductors) by using 50 mm² Cu conductors. Continuity of the earthing of cable trays can be done by using factory made parts. In case aluminum cable trays are used then cable trays can also be connected with an aluminum rope (instead of copper) which is mounted on the tray. one end has be connected to the nearest EB-bar

4.3.2 Cranes

Crane rails will be connected to the equipotential bonding network. See appendix 1.

4.3.3 Tanks

Large metallic tanks will be connected straight to earthing electrode by 120 mm² Cu conductors (2-4 connection/tank).

Smaller tanks inside the buildings will be connected to the nearest EB-bar by using 70 mm² Cu conductors (at least one connection/tank).

4.3.4 Pipes

All incoming conductive pipes inside the buildings will be earthed to the nearest EB-bar. Connections will be made by 70 mm² Cu conductor. Additionally the pipes have to be earthed on the pipe bridge.

4.3.5 Motors

PE-wire of the every motor cable shall be connected to PE-bar at MCC and to PE-terminal at terminal box of the motor.

MV-motors frame shall also be connected to the nearest EB-bars by using 70 mm² Cu conductors.

LV-motors frame (over 90 kW) shall be connected to the nearest EB-bars (with approval of the purchaser). Conductor size 50 % of phase conductors size of the motor cable, but not less than 50 mm² Cu.

4.3.6 Major Process Equipment

Major process equipment and large metal constructions will be earthed to the two nearest EB-bar by using 70 mm² Cu conductors.

4.3.7 Supplementary Equipotential Bonding

Supplementary bonding will be done when necessary according to standards (IEC 60364-5-54).

5 SYSTEM EARTHING

The power distribution systems medium voltage and low voltages earthing methods which will be used are (to be agreed with Purchaser with system to use):

System	Earthing method.
20kV	Unearthed system
6kV and 10 kV	Resistance earthed system or unearthed system
690 V	Solidly earthed TN-S system without neutral.
690V Sectional drives	Resistance earthed IT -system
400 V	Solidly earthed TN-S system.

5.1 General

Equipment earthing will be made with earthing conductors which are required to run with (or close by) the circuit conductors to provide a permanent, low-impedance conductive path for ground-fault current.

5.2 Transformers and Bus Ducts

Transformer high voltage sides earthing will be made by connecting HV-cable sheaths and transformer tank to EB-bar in the transformer rooms.

In low voltage side, transformer tank and bus duct will be connected to the switchgear/MCC earthing bar (PE). This connection will be made by earthing wire/bar which should be included the bus duct construction. Connection provides a low-impedance path for the fault current and it should be rated at the same values as bus duct.

5.3 Power Switchgear

MV-switchgears (20 kV, 10kV and 6 kV) shall have earthed PE-bars. All MV-cable sheaths will be connected to these bars.

690 V and 400V main switchgears have earthed PE-bars which will be connected to the feeding transformer neutral pole by using PE-cable of the HCC-link. PE-conductors of installation cables will be connected to the PE-bars of the switchgears.

Sub MCCs (690 V and 400V) PE-bar will be earthed through the ground conductor (PE) of the MCC feeder cable.

5.4 Lighting Boards and Panels

Each lighting distribution main board (400 V) has earthed PE-bar which will be connected to the feeding transformer neutral pole by using PEN-cable. The separation of N-PE is done inside the board. All cables shall have 5-conductors (TN-S) and cables PE-conductors will be connected to the PE-bar of board.

Each lighting sub panel PE-bar shall be earthed through the protective conductors (PE) of feeder cable.

5.5 Motors

The metallic sheaths/armor of MV-motor feeder cable(s) shall be connected to the motor frame and another end to the PE-bar of the feeding SWG.

Low voltage motors shall be earthed through the motor feeder cable(s) protective conductor.

VFD operated LV motors shall be grounded according the VFD supplier specification.

VFD operated LV motor, gear box and process equipment shall be grounded together with flexible braided ground straps.

5.6 Power Cables

Each feeder or motor cable shall include earthing wire all the way from the feeding panel or MCC.

Metallic sheaths (metal enclosures, armors, screens) of the power cables with nominal voltages above 1 kV should be earthed at both ends.

EMC shielded cables should be used for VSD used motors.

6 FE-NETWORK

Separate Functional Earthing (FE) network. FE will be connected to the PE-earth bar inside the rack.

If DCS or other electronics system will need a separate FE system, it will be made according to supplier instructions.

Screened signal cables shall be used for low voltage signals. The screen will be connected to functional earthing (FE) in electrical or rack rooms. The screen will be isolated in the field end.

Separate dedicated earthing bars will be installed for signal earthing. Only control system signal earths and signal cable shields will be connected to functional earthing bars.

Functional earthing bars (FE) will be connected to protective earthing bars (PE) with 120 mm² Cu cable. There will not be separate earth electrode for functional earthing.

Black insulated Cu-cables, marked with FE, will be used for signal functional earthing.

The functional earthing system principles are shown in appendix 1 (400 V TN-S systems).

7 EXPLOSION HAZARD AREA

All metal tanks, conductive pipes and PE-terminals of electrical equipment shall be connected to the equipotential bonding bar. Equipotential bondings inside the explosion hazard area shall be done according IEC-60079-14 standard.

All earth conductors above earth shall be so located as to be readily visible for inspection.

8 LIGHTNING PROTECTION

In the beginning of design phase a lightning protection risk assessment shall be made according to standard EN 62305-2. According the result will be determined the lightning protection level.

All buildings with explosion hazard area, tanks containing flammable liquid and high chimneys shall be protected according IEC 62305 standards. The protection class shall be defined due in risk analysis.

Pigtails for lightning protection net will be taken up at every outside corner of the building and also about every third outside wall building column.

Lightning protection system shall be used in roof rods, which will be connected to columns of building to be used as down conductor and connected to earthing system. Lightning protection system shall be carried out according to standard EN 62305-3. Internal lightning protection system shall be provided according to lightning protection level.

The bare Fe/Zn-wire, bare Cu conductor or flat bar iron lightning protection net will be installed on the roof of each building.

All metallic parts on the roof shall be connected to the lightning protection net (hand trails, walkways, cable trays, ventilation equipments, etc.). Also metal-sheeted outside walls shall be connected to the lightning protection net.

Lightning protection net shall be connected to the main earthing electrode. Interval of the connection points shall be about every third wall column (outside walls) and every outside corner of the building.

Distribution transformers and main transformers are equipment with surge protectors.

Each MCC and main boards together with lighting distribution boards are equipped with surge protector.

9 EARTHING BAR NUMBERING

The numbering instruction for the earthing bars are plant specific. The purchaser must always confirm the numbering instruction.

In case there are no existing plant standards to be followed then the following standard applies.

Earthing bars are to be numbered by the nearest main equipment such as Transformer, MCC or tank. At the process area some bars shall be numbered by column numbers. Least two characters are always EB.

The numbering instruction for the earthing bars are factory specific. The purchaser must always confirm the numbering instruction.