Bosch-Norm

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Delivery instructions for ESD-adjusted production components

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This Bosch-Norm is binding for suppliers if it is part of the order.

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1 Scope

This Bosch-Norm includes delivery instructions for ESD-compatible production components.

2 Binding force for suppliers

The supplier accepts the obligation to comply with the instructions current at the time the order was placed. Technically necessary deviations from the requirements need the prior approval of the customer. Deviations **without the (prior) approval** have to be changed by the supplier **free of charge**. The cooperation of the customer in the technical solution or the approval of design characteristics does not relieve the supplier of the sole responsibility for flawless function and do not restrict the assured properties in any way.

3 Definitions

The following definitions are applicable for using this Bosch-Norm:

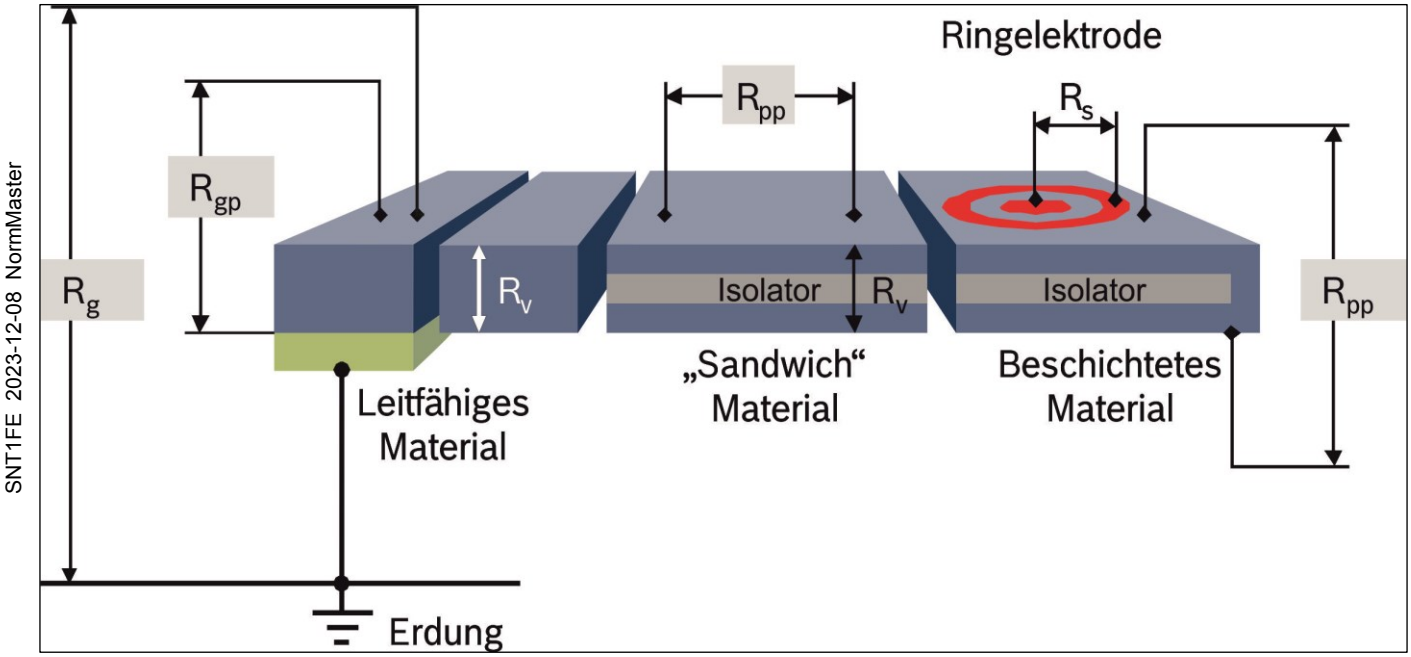

Figure 1 Definitions for the surface, volume and leakage resistances

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- **ESD**
  (Short for **E**lectro**s**tatic **D**ischarge) Equipotential bonding between charged bodies caused by gas discharges, direct contact or breakdown mechanisms in solids.
- **ESDS**
  (Short for **E**lectro**s**tatic **d**ischarge **s**ensitive device) Collective term for all individual components, integrated circuits or assemblies (e.g. printed circuit board assemblies or complete electronic control units) that may be damaged by electric fields or electrostatic discharge during handling, testing or transport.
- **Equipotential bonding**
  Electrically conductive connection between conductive parts in order to eliminate differences in potentials between these parts.
- **R_g resistance to earth**
  This is the leakage resistance against the grounding potential.
- **R_{gp} leakage resistance**
  The leakage resistance is a measure for the electrical conductivity between a random point of a test specimen and its groundable point or contact to the grounding potential.
- **R_s and/or R_{pp} surface resistance**
  The surface resistance is a measure for the conductivity of the surface. The measurement is performed either as a "point-to-point measurement" (R_{pp}) with two individual measuring electrodes, or as R_s by means of of a ring electrode (standardized structure of two concentric rings).
- **R_v Volume resistance**
  The volume resistance R_v (or volume resistivity) is a measure for the electrical conductivity through the body of a test specimen. The current flow along the surface of the test specimen is not considered.
- **Electrically conductive ($R_{pp} < 10^2\ \Omega$)**
  Materials which, due to their atomic structure (free electrons), can transmit the electrical current, are called electrically conductive.
- **Electrostatically conductive ($R_{pp} < 10^5\ \Omega$)**
  Materials with a conductivity sufficient for ESD-protection.
- **Electrostatically dissipative**
  When voltage differences are equalized in a defined short time, then this refers to electrostatically dissipative properties. In the EPA one potential normally corresponds to that of the groundable point.
- **Insulating ($R_{pp} > 10^{11}\ \Omega$)**
  Materials that are neither electrically conductive nor electrostatically conductive nor electrostatically dissipative.

4 Use of products of the Bosch Group

Components and products of the Bosch Group program are to be preferred, e.g. of Bosch Rexroth. Information and advice through the responsible sales offices or technical departments.

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5 Production components

Production components, as defined by this Bosch-Norm, are single parts or assemblies used for the production of ESD-compatible production installations. Here, a distinction is made between components without direct contact to ESDS (table 1) and those with direct contact to ESDS (table 2).

Components of metal may be delivered with or without surface coating, depending on the order. Surface-coated metals must have dissipative properties. In these cases, conductive transitions to the equipotential bonding have to be provided.

Components of plastic may be delivered with or without surface coating, depending on the order. Uncoated plastics have to be volume-conductive, coated plastics should be surface-conductive.

Energy can be saved by the preferred use of **machine components without compressed air**.

In addition, all requirements as per N51M M20 - General delivery instructions for machinery, installations and production equipment (MAE) - are valid.

6 Cable for equipotential bonding

A cable with **transparent insulation** is recommended as the connecting cable for an equipotential bonding between 2 components (e.g. ESD-safety pane and metal frame) in terms of ESD-protection. Cables with insulation in colors that are defined for live lines as per DIN/VDE (black, brown, blue, gray) should not be used. Cables with monochrome yellow or green color or in red should be avoided as well.

If a cable with yellow-green insulation is used for equipotential bonding (PE-/PEN-protective conductors), the rules as per the external standards series DIN VDE 0100 (personnel protection) and/or the manufacturer safety instructions are to be adhered to as well as the local, national statutory regulations and international guidelines.

Highly flexible cable must be used for movable components such as doors, drawers.

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7 Identification

ESD-compatible production components in EPA-areas have to be marked with the usual international signs as per **the international standards series 61340**.

8 Preconditions for ESD-release

The measurement procedures and the tests correspond to **the international standards series 61340**. The tests of the material properties such as dissipative resistance and/or surface resistance and occurring field strengths have to be performed and documented by the manufacturer according to **the international standards series 61340**. The documentation has to include the ambient conditions at the time of measurement (temperature and humidity).

In unmounted condition:

Generally, the following specified surface resistances (R_{pp}) have to be adhered to for components used within any production equipment and/or materials enclosing and/or covering the equipment:

- for components with direct contact to the ESDS: $10^4 < R_{pp} < 10^9\ \Omega$
- for components without direct contact to the ESDS: $R_{pp} < 10^9\ \Omega$

In mounted condition:

It has to be assured that the resistance to earth R_g or the leakage resistance R_{gp} of the used production component is adhered to:

- components with direct contact to the ESDS: $10^4 < R < 10^9\ \Omega$
- components without direct contact to the ESDS: $R < 10^9\ \Omega$.

If these specifications are met, documented and confirmed in an acceptance protocol, then this will simplify the final release by the ESD-coordinator and/or ESD-representative of the respective plant.

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These measurements have to be performed on each installation (production component) and the results have to be provided prior to delivery.

A documentation should accompany the delivery. It can be a proprietary one or one similar to the one used in appendix 1 (checklist) and appendix 2 (flow chart).

If these specifications cannot be met due to technical reasons, then it is permissible to use insulating materials (> 10^9 Ohm) through shielding, e.g., a metallic guiding or sheathing. Thus, the impact of electrical fields on the ESDS is no longer possible. Such design solutions have to be agreed with the ESD-coordinator in advance.

If the shielding of non ESD-suitable plastics it is not possible due to technical and design reasons, a minimum gap of approx. 30 cm between ESDS and insulating materials is sufficient in many cases.
Since environmental conditions, materials used and the sensitivity of the ESDS are different, it is always mandatory to coordinate this solution with the ESD-coordinator.

It is not a safe and suitable solution to use ionizers in order to neutralize non ESD-suitable plastics on the surface because the air flow acts only horizontally and not spatially. Several ionizers would have to be installed three-dimensionally, which would complicate the solution very complicated.

Using ionizers

In case the charging of ESDS (components, assemblies, products, ...) is not avoidable, it is important to neutralize them before the next contact with conductive materials in order to prevent a hard discharge. The ESD-coordinator can provide support for the selection of suitable ionizers. The ESD-coordinator and/or ESD-representative have to substantiate the efficacy of the ionizer based on measurements. The test of the ionizers must be possible without bypassing the safety devices (e.g., activating manual mode via the service menu). In the current mode, the function of the ionizer must be monitored by the control unit.

A standard release for worldwide applied equipment would be permissible under the condition that the above stated requirements are fulfilled. For this, it is a prerequisite that the equipment is absolutely identical and intended for the same application. The final release can only be given by taking into account the environmental conditions and the robustness of the ESDS after the assessment of the ESD-coordinator and/or ESD-representative of the respective plant.

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Table 1 Components in production installations **without** direct contact to ESDS

No.	Group	Model variant	Material			Mounting instructions for assemblies	Example No. (Table 3)
			Type	Properties	Limit values		
A.00.01	Safety covers	Safety panes, safety tunnels	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	2, 3
A.00.02			Plastics	Both surfaces electrostatically dissipative			-
A.00.03			Plastics, transparent				4
A.00.04			Plastics, transparent	Both surfaces electrostatically dissipative. Bent (safety tunnel)	$R_{pp} < 10^9\ \Omega$	Im mounted condition on horizontal and vertical internal/external surfaces $R_g/R_{gp} < 10^9\ \Omega$	39
A.00.05			Glass	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.01.01	Guard doors	Hinges, door frames, guide rails	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	19, 21, 23
A.01.02			Plastics				19, 21, 23
A.01.03				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	20, 22, 24
A.02.01	Fasteners for safety panes	Screwed on profile	Metals	No ESD requirements	-	-	9, 10, 11, 12
A.02.02		With Variofix-Block	Plastics				13, 14
A.02.03		In mounting rim profile	Rubber				4, 15 - 18
A.03.01	Equipotential bonding components	ESD shackle	Galvanized steel or high-quality steel	conductive	$R_{pp} < 10^2\ \Omega$	-	8, 16, 18
A.03.02		Flexible lines, connecting elements	Copper line or EMC strips with transparent insulation				1, 4, 24
A.04.01	Frames and racks	Profile design (screwed)	Metals	Electrostatically dissipative	$R_{gp} < 10^9\ \Omega$	Anodized surfaces with conductive profile transitions	1, 24
A.04.02		Welding construction					-
A.05.01	Connecting elements for profiles	Screws, hexagon nuts	Metals	Electrostatically dissipative	$R_{gp} < 10^9\ \Omega$	Chequered/ toothed contact surface for improving contact with anodized or varnish coatings	1, 9
A.05.02		Hammerhead nuts					1, 24
A.05.03		Sliding blocks					
A.05.04		Flat washers, toothed lock washers					1, 9, 10
A.05.05		Profile connectors					-

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Table 1 Components in production installations **without** direct contact to ESDS (continued)

No.	Group	Model variant	Material			Mounting instructions for assemblies	Example No. (Table 3)
			Type	Properties	Limit values		
A.06.01	Mounting plates	Base plates	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	5, 6, 7
A.06.02			Plastics				
A.06.03			Other nonmetals	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E< 50 V/cm at ESDS	-
A.07.01	Hydraulics, cooling, heating, pneumatics, vacuum devices and their installation equipment	Maintenance units, valves, cylinders, pipes, hoses	Metals/metal-sheathed	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	-
A.07.02			Plastics				34
A.07.03			Plastics/other nonmetals	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.08.01	Electrical devices and their installation equipment	Electrical lines, connecting elements	Metals (plastics)	No ESD requirements	-	Mind distance! Field strength E < 50 V/cm at ESDS **Recommendation:** Install in cable duct	-
A.08.02		Cable ducts	Metals	Electrostatically dissipative, or shielding	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	-
A.08.03			Plastics				-
A.08.04				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	25
A.08.05		Distributors, covers, junction boxes, casings	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	26
A.08.06			Plastics	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.08.07		Energy supply chains	Plastics	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	28
A.08.08				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.09.01	Handling systems	Robots, autonomous transport systems e.g. AGV's axle systems, feed, tools	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	39
A.09.02			Plastics				25, 39
A.09.03				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	39

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No.	Group	Model variant	Material			Mounting instructions for assemblies	Example No. (Table 3)
			Type	Properties	Limit values		
A.10.01	Identification systems, measuring instruments, electrical devices, IT-equipment	e.g. scanners, writing-/ reading station (SLS), light barriers, camera systems, TFT, RFID components etc.	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	-
A.10.02			Plastics/ other nonmetals	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.11.01	Integrated manual workplaces	Arm rests	Plastics	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	31
A.11.02		Footrests	Metals/ plastics				31
A.11.03		Seating	Metals/plastics/textiles				31
A.11.04		Tool trays	Metals/ plastics				32
A.11.05		Lighting	Metals				-
A.11.06			Plastics				-
A.11.07				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
A.12.01	Workplace documentation	Supports	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	27
A.12.02		Folders	Plastics				27
A.12.03			Plastics/ paper	Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	27
A.13.01	Contact equipment	Contact pin holder	Plastics	Insulating	$R_{pp} > 10^{11}\ \Omega$	Field strength E < 50 V/cm at ESDS	-
A.14.01	Workpiece carriers	Product fixings	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	-
A.14.02			Plastics				30
A.14.03				Insulating	$R_{pp} > 10^{11}\ \Omega$	Field strength E < 50 V/cm at ESDS	-

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Table 1 Components in production installations **without** direct contact to ESDS (continued)

No.	Group	Model variant	Material			Mounting instructions for assemblies	Example No. (Table 3)
			Type	Properties	Limit values		
A.15.01	Feeders	Transport belts, conveyor units, directional guides, spiral/vibratory conveyors	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	29
A.15.02			Plastics				-
A.16.xx	All other components in production installations **without** direct contact to the ESDS	All	Metals	Electrostatically dissipative	$R_{pp} < 10^9\ \Omega$	In mounted condition $R_g/R_{gp} < 10^9\ \Omega$	-
			Plastics/other nonmetals				-
				Insulating	$R_{pp} > 10^{11}\ \Omega$	Mind distance! Field strength E < 50 V/cm at ESDS	-
			Insulated conductor	Insulating	Rg > $10^9\ \Omega$ U < 35	Only after consulting with customer, ESD-assessment required! In mounted condition. Voltage measurement after process performance, e. g. holding-down device in test cassette (not grounded and insulated toward the ESDS)	37, 38

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Table 2 All other components in production installations **with** direct contact to the ESDS

No.	Group	Model variant	Material			Mounting instructions for assemblies	Example No. (Table 3)
			Type	Properties	Limit values		
B.00.01	Feeders	Transport belts, directional guides	Plastics	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	29
B.00.02		Feeder units					-
B.00.03	Transport system	Transport belts	Plastics	On both sides Electrostatically dissipative preferably volume-conductive	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\Omega$	29
B.01.01	Workpiece carriers	Product fixings	Plastics	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	-
B.01.03		Nest lining					30
B.02.01	Shelves	Drawers, racks	Plastics	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	32
B.02.02		Containers					33
B.03.01	Handling systems, robots, autonomous transport systems, e.g. AGV's	Vacuum suction devices	Plastics	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	-
B.03.02		Gripper of a robot or axle systems					39
B.03.03	Pick-and-place machines	Nozzle, pipette	Metals/ other nonmetals	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	36
B.04.01	Holding-down devices	Positioning accessories	Plastics	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	-
B.05.01	Workplace surfaces	Work tables	Plastics/other nonmetals	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	7, 35
B.05.02		Table coverings					-
B.06.xx	All other components in production installations **with** direct contact to the ESDS	All	Metals	conductive	$R_{pp} < 10^5\ \Omega$	Only after consulting with customer, ESD-assessment required! In mounted condition Voltage measurement after process performance, e. g. separation process (insulated milling cutter), holding-down device	-
			Insulated conductor	conductive	$R_{gp} > 10^5\ \Omega$ $R_{pp} < 10^9\ \Omega$ U < 35 V		38
			Plastics/other nonmetals	Insulating	$R_{pp} > 10^{11}\ \Omega$		-
			Plastics/ metals (coated)	Electrostatically dissipative	$10^4 < R_{pp} < 10^9\ \Omega$	In mounted condition $10^4 < R_g/R_{gp} < 10^9\ \Omega$	-

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Table 3 Examples

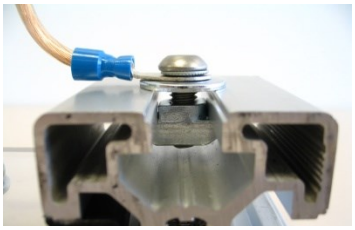
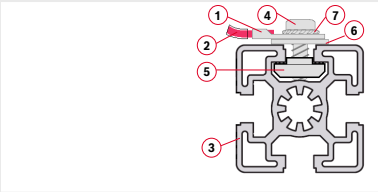
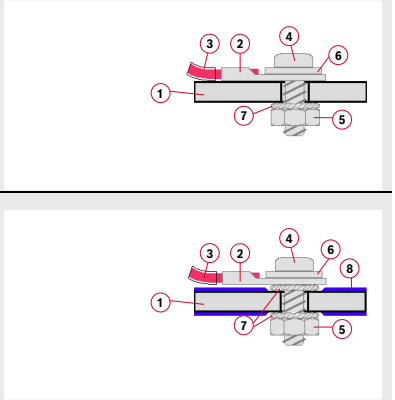
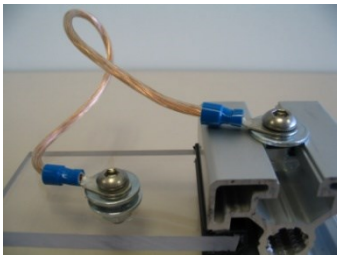
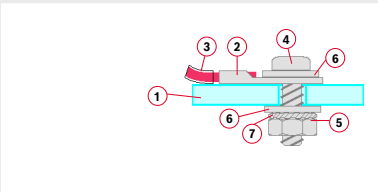
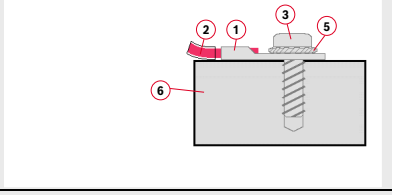
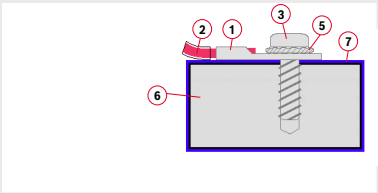
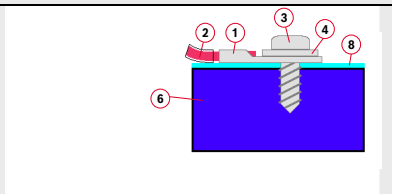
No.	Designation	Comments	Examples	
1	Fastening the cable for equipotential bonding at the Bosch-profile	1. Terminal lugs A.03.02 2. Equipotential bonding cable A.03.02 3. Bosch-Profile A.04.01 4. Bolt A.05.01 5. Hammerhead nut A.05.02 6. Flat washer A.05.04 7. Toothed lock washer A.05.04		
2	Fastening the cable for equipotential bonding at an uncoated metal plate	1. Metal plate A.00.01 (Coating must have been removed) 2. Terminal lugs A.03.02 3. Equipotential bonding cable A.03.02 4. Bolt A.05.01 5. Hexagon nut A.05.01 6. Flat washer A.05.04 7. Toothed lock washer A.05.04 8. Coating (Insulator)		
3	Fastening the cable for equipotential bonding at a metal plate with an insulating coating			
4	Fastening the cable for equipotential bonding at a plastic plate (both surfaces electrostatically dissipative)	1. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 2. Terminal lugs A.03.02 3. Equipotential bonding cable A.03.02 4. Bolt A.05.01 5. Hexagon nut A.05.01 6. Flat washer A.05.04 7. Toothed lock washer A.05.04		
5	Fastening the cable for equipotential bonding at a mounting plate that isconductive and/or dissipative	1. Terminal lugs A.03.02 2. Equipotential bonding cable A.03.02 3. Bolt A.05.01 4. Flat washer A.05.04 5. Toothed lock washer A.05.04 6. Mounting plate A.06.01 7. Coating (insulator) 8. Coating B.02.01/ (conductive and/or dissipative) B.05.01		
6	Fastening the cable for equipotential bonding at a mounting plate with a conductive and/or dissipative and insulating coating			
7	Conductive and/or dissipative coatings on insulators			

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Table 3 Examples (continued)

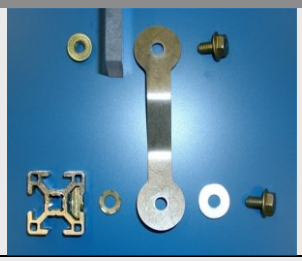
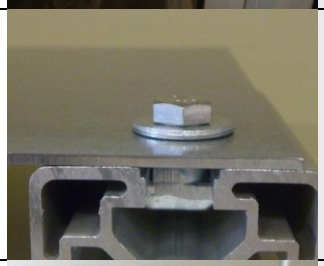
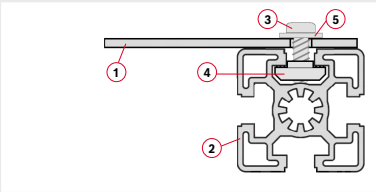
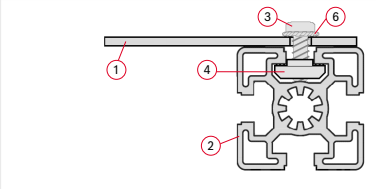
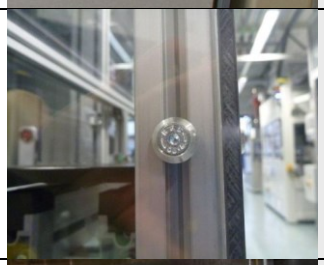
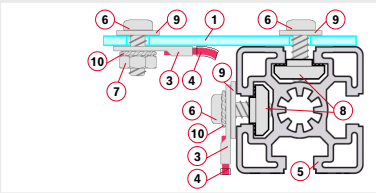
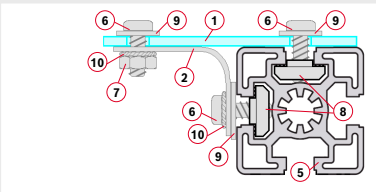
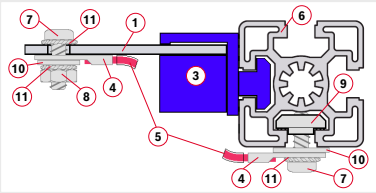
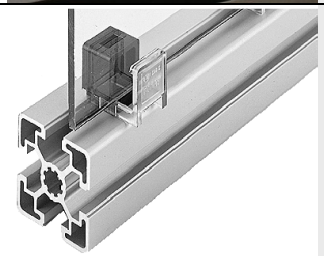
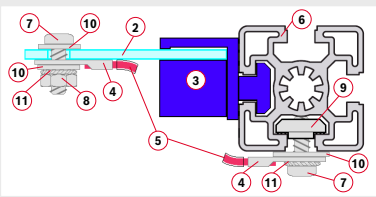
No.	Designation	Comments	Examples
8	ESD shackle	e.g. Bosch Rexroth Order number 3 842 536 148	
9	Uncoated metal sheet **(no aluminum)** screwed to Bosch-profile	1. Metal plate A.00.01 2. Bosch-Profile A.04.01 3. Bolt A.05.01 4. Hammerhead nut A.05.02 5. Flat washer A.05.04 6. Toothed lock washer A.05.04	 
10	Uncoated aluminum plate screwed to Bosch profile		
11	Plastic plate (both surfaces electrostatically dissipative) screwed on Bosch-profile	1. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 2. ESD shackle A.03.01 3. Terminal lugs A.03.02 4. Equipotential bonding cable A.03.02 5. Bosch-Profile A.04.01 6. Bolt A.05.01 7. Hexagon nut A.05.01 8. Hammerhead nut A.05.02 9. Flat washer A.05.04 10. Toothed lock washer A.05.04	 
12			
13	Metal plate connected with Bosch-profile by Variofix-Block	1. Metal plate A.00.01 2. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 3. Variofix-Block A.02.02 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04	
14	Plastic plate (both surfaces electrostatically dissipative) connected through Variofix-Block with Bosch-profile		 

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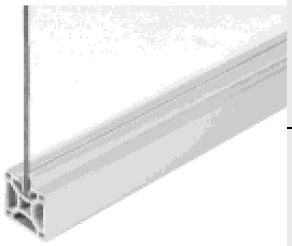
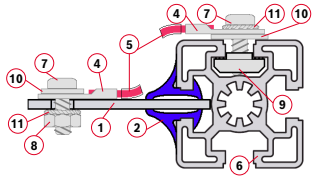
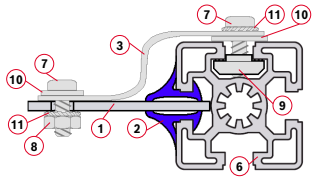
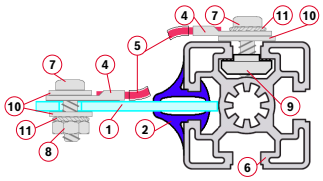
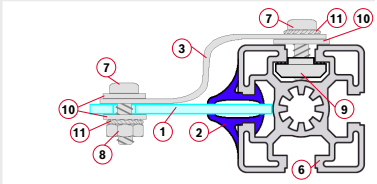
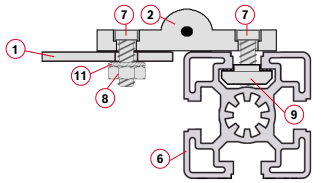
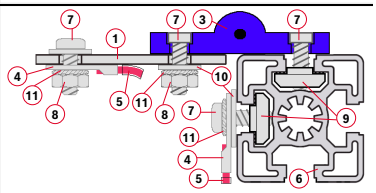
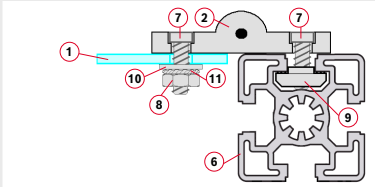
Table 3 Examples (continued)

No.	Designation	Comments	Examples	
15	Metal plate inserted with mounting rim profile in Bosch-profile	1. Metal plate A.00.01 2. Mounting rim profile A.02.03 3. ESD shackle A.03.01 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04		
16				
17	Plastic plate (both surfaces electrostatically dissipative) inserted with mounting rim profile in Bosch-profile	1. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 2. Mounting rim profile A.02.03 3. ESD shackle A.03.01 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04		
18				
19	Metal sheet with conductive or dissipative ball joint screwed to Bosch-profile	1. Metal plate A.00.01 2. Ball joint A.01.01/02 3. Ball joint A.01.03 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04		
20	Metal sheet screwed with plastic ball joint (insulator) to Bosch-profile			
21	Plastic plate (both surfaces electrostatically dissipative) screwed with conductive or dissipative ball joint to Bosch-profile	1. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 2. Ball joint A.01.01/02 3. Ball joint A.01.03 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04		

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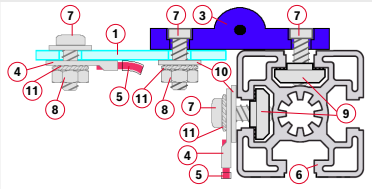
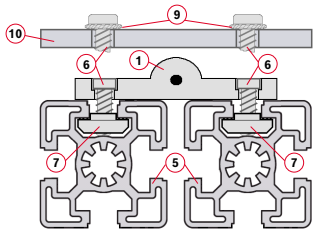
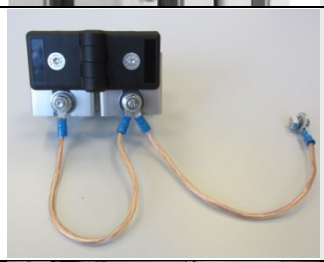
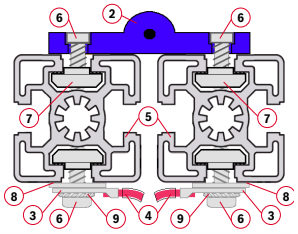
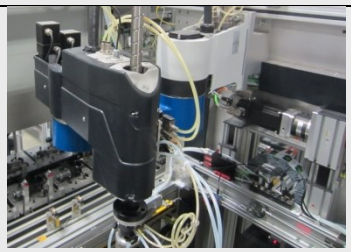
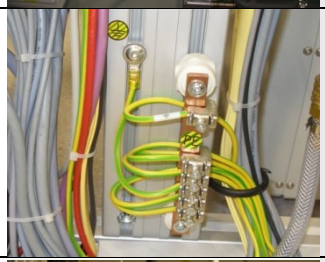
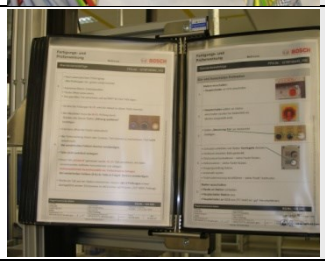
No.	Designation	Comments	Examples	
22	Plastic plate (both surfaces electrostatically dissipative) screwed with plastic ball joint (insulator) to Bosch-profile	1. Plastic plate A.00.02/03 (possibly both sides with conductive rubber) 2. Ball joint A.01.01/02 3. Ball joint A.01.03 4. Terminal lugs A.03.02 5. Equipotential bonding cable A.03.02 6. Bosch-Profile A.04.01 7. Bolt A.05.01 8. Hexagon nut A.05.01 9. Hammerhead nut A.05.02 10. Flat washer A.05.04 11. Toothed lock washer A.05.04		
23	Connect Bosch-profiles with metal strip or with conductive or dissipative ball joint	1. Ball joint A.01.01/02 2. Ball joint A.01.03 3. Terminal lugs A.03.02 4. Equipotential bonding cable A.03.02 5. Bosch-Profile A.04.01 6. Bolt A.05.01 7. Hammerhead nut A.05.02 8. Flat washer A.05.04 9. Toothed lock washer A.05.04 10. Profile connector A.05.05		
24	Connect Bosch-profiles with metal strip or with plastic ball joint (insulator)			
25	Plastic cable ducts	Distance to ESDS as large as possible 1. Placing under machine 2. Placing behind machine 3. Placing above machine Alternative option: Dissipative powder coating Cable ducts A.08.03		
26	Collective earth connection /rail for equipotential bonding / central grounding strip	Note rules for use of cables with yellow/green identification. Distributor A.08.05		
27	Workplace documentation	Holders A.12.01 Folders A.12.02 Folders A.12.03		

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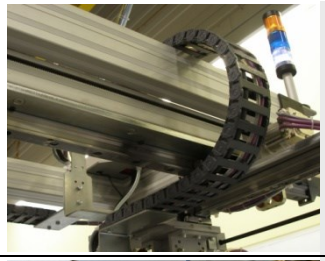
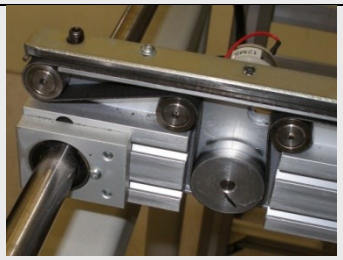
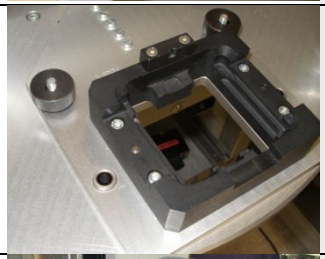
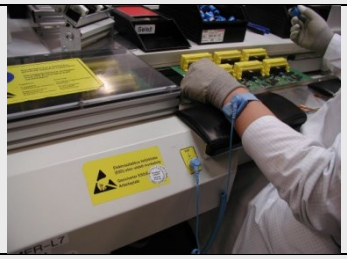
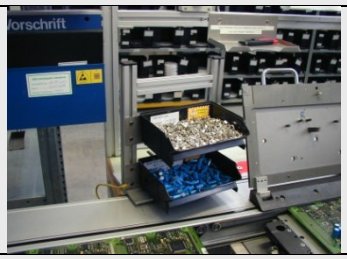
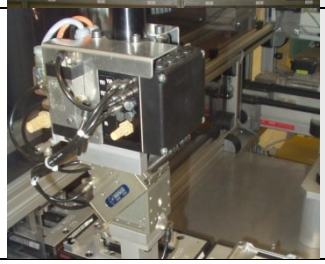
No.	Designation	Comments	Examples	
28	Plastic energy supply chains	Energy supply chains A.08.07 Distance to ESDS as large as possible Energy supply chains A.08.08		
29	Transport belts, directional guides	Only dissipative transport belts permissible. Primary volume conductive Rv 10^4 < Rv < 10^9 Ω Transport belts B.00.03 directional guides B.00.01		
30	Product fixings Nest linings	Nest linings B.01.03		
31	Integrated manual workplaces	Arm rests A.11.01 Footrests A.11.02 Seating A.11.03 Tool shelves A.11.04		
32	Shelves, drawers	No "hard discharge" of ESDS. Drawers B.02.01		
33	Shelves, racks, containers	No "hard discharge" of ESDS. Racks B.02.01 Containers B.02.02		
34	Pneumatics equipment	Pneumatic hoses A.07.02		

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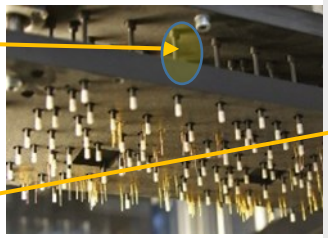
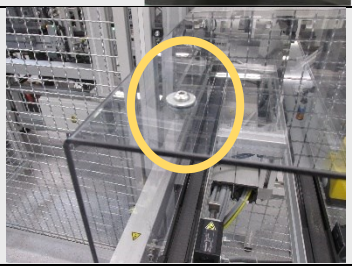
No.	Designation	Comments	Examples
35	Workplace surfaces	No "hard discharge" of ESDS. Work surfaces B.05.01 Table covers B.05.02	
36	Nozzle	No charge or "hard discharge" of ESDS. Nozzle B.03.03	
37, 38		Charging< 35V (metal parts) of not grounded machine parts Base body of holding-down device/counter holder A.16.xx milling spindle with brush B.06.xx	
39	Robots, autonomous transport system, e.g., AGV's	Grippers, shelves	
40	Safety covers	Bent, coated panes	

9 Normative references

The following documents are necessary for using this Bosch-Norm. With dated references, solely the edition referred to applies. With undated references, the last edition of the indicated document applies (including all revisions). Intentionally cited historical documents are additionally identified as "H" in the column "Type."

No.	Document number (edition date)	Title	Type
1	N51M M24 Attachment 1	Checklist	M
2	N51M M24 Attachment 2	Sequence chart	M
3	N51M M20	General delivery instructions for machines, installations and production equipment (MAE)	M
4	DIN VDE 0100	Low-voltage installations	Z
5	Standards series 61340	Electrostatics	Z

Type M = document to be supplied; Z = cited document; H = historical document

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