

Extract DIN VDE 0110-04.97^{*)}

This standard is a technical adaptation of IEC Report 664/664A and specifies, in general, the minimum insulation distances for equipment. It can be used by committees to protect persons and property in the best possible way from the effects of electrical voltages or currents (e.g. fire hazard) or from functional failure of the equipment by providing adequate dimensioning of clearances and creepage distances in equipment.

Rated impulse without voltage

In allocation of the equipment to an installation category, the following factors shall be taken into account:

- Overvoltages which can enter the equipment from outside across the terminals.
- Overvoltages generated in the equipment itself and occurring at the terminals.

The following parameters apply to:

Installation category I

Equipment is intended for use only in appliances or installation parts, in which no overvoltages can occur.

Equipment in this installation category is normally operated at extra low voltage.

Installation category II

Equipment is intended for use in installations or parts of installations, in which lightning overvoltages need not be considered. Overvoltages caused by switching must be taken into account.

This includes for example domestic appliances.

Installation category III

Equipment is intended for use in installations or parts of installations, in which lightning overvoltages need not be considered, but which are subject to particular requirements with regard to the safety and availability of the equipment and its supply systems.

This includes equipment for fixed installation such as protective devices, relays, switches and sockets.

Installation category IV

Equipment is intended for use in installations or parts of installations, in which lightning overvoltages must be taken into account.

This includes equipment for connection to overhead lines such as omnidirectional control receivers and meters.

For circuits or parts of circuits inside the equipment, clearances may be dimensioned directly for the expected overvoltages. If the expected overvoltages are not impulse voltages but DC or AC voltages, the maximum value of these voltages shall be determined as the rated impulse withstand voltage for clearances both for homogeneous and inhomogeneous field.

Degree of pollution

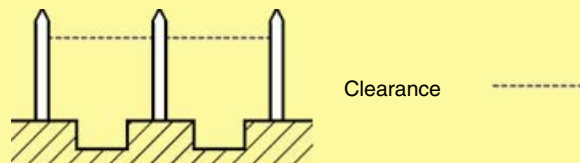
Pollution degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2: Only non-conductive pollution occurs. A temporary conductive caused by condensation must be expected occasionally.

The degrees of pollution 3 and 4 are in this case not considered, as they are not relevant for the connectors shown in this catalogue. The minimum creepages in table 00.04 refer to the CTI-value for insulation group III a/b.

Clearance

The clearance is defined as shortest distance through the air between two conductive elements.



To identify the clearance distance

- Define the installation category
- Define the degree of pollution expected
- Select the rated impulse withstand voltage from table 00.01
- Select the minimum required clearance from table 00.02

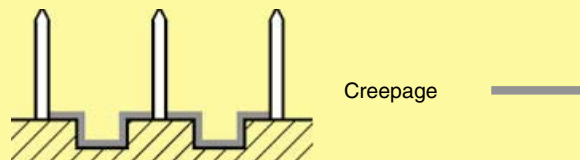
Exemplary calculation

What voltage can be used, if the clearance, the installation category and the degree of pollution are known:

Clearance	Installation category	Degree of pollution	Voltage phase-to-earth
1.2 mm	II	2	150 V
3.0 mm	II	2	600 V
4.5 mm	II	2	600 V

Creepage

The creepage is defined as shortest distance on the surface of an insulating material between two conductive elements.



To identify the creepage distance

- Define the installation category
- Define the degree of pollution expected
- From the nominal voltage and the type of supply system select the rated voltage from table 00.03 a/b
- From the rated voltage and degree of pollution select the minimum creepage required in table 00.04

For the dimensioning of the creepage distance the tracking formation of the insulating material has to be considered. If not indicated contrary, the CTI value of the insulating material is <400 and the isolation group is III a/b.

Exemplary calculation

What voltage can be used, if the creepage, the installation category and the degree of pollution are known:

Creepage	Installation category	Degree of pollution	Nominal voltage of supply system
1.2 mm	II	2	50 V
3.0 mm	II	2	220 V
8.0 mm	II	2	600 V

^{*)} It is the users responsibility to ensure that the complete current issue of the specification is considered.

Table 00.01

Voltages phase-to-earth derived from rated system voltages up to $U_{r.m.s.}$ and U_0	Rated impulse withstand voltages in kV for installation category (Voltage form: 1.2/50 μ s according to DIN IEC 60 060-1)			
	I	II	III	IV
50	0.33	0.50	0.80	1.5
100	0.50	0.80	1.5	2.5
150	0.80	1.5	2.5	4.0
300	1.5	2.5	4.0	6.0
600	2.5	4.0	6.0	8.0

Table 00.02

Rated impulse withstand voltage in kV	Minimum clearances in mm up to 2000 m above sea level ¹⁾			
	Case A (Inhomogeneous field ³⁾)		Case B (Homogeneous field ²⁾)	
	Pollution degree		Pollution degree	
	1	2	1	2
0.33	0.01	0.2	0.01	0.2
0.50	0.04		0.04	
0.80	0.1		0.1	
1.5	0.5	0.5	0.3	0.3
2.5	1.5	1.5	0.6	0.6
4.0	3	3	1.2	1.2
6.0	5.5	5.5	2	2
8.0	8	8	3	3

¹⁾ For higher altitudes see table 2b from DIN VDE 0110 for multiplying factors.
²⁾ Verification by an impulse voltage test is required if the clearance is less than the value specified for case A.
³⁾ Point to plane.

Table 00.03 a. Single phase, three or two wire AC or DC systems

Table 00.03 b. Three phase, four or three wire AC systems

Nominal voltage of supply system ¹⁾	Rated voltage in V		Nominal voltage of supply system ¹⁾	Rated voltage in V		
	Phase-to-phase All systems (between conductors of different polarity for U_0)	Phase-to-earth		Phase-to-phase	Phase-to-earth	
$U_{r.m.s.}$ or U_0 in V	$U_{r.m.s.}$ or U_0	$U_{r.m.s.}$ or U_0	$U_{r.m.s.}$ in V	$U_{r.m.s.}$	$U_{eff.s.}$	$U_{eff.s.}$
12.5	12.5	–	60	63	32	63
24	25	–	110	–	–	–
25	25	–	120	125	80	125
30	32	–	127	–	–	–
42	–	–	150 ²⁾	160	–	160
48	50	–	208	200	125	200
50 ²⁾	–	–	220	–	–	–
60	63	–	230	250	160	250
60/30	63	32	240	–	–	–
100 ²⁾	100	–	300 ²⁾	320	–	320
110	125	–	380	–	–	–
120	–	–	400	400	250	400
150 ²⁾	160	–	415	–	–	–
220	250	–	440	500	250	500
220/110	–	–	480	500	320	500
240/120	250	125	500	630	400	630
300 ²⁾	320	–	600 ²⁾	630	–	630
440/220	500	250	660	630	400	630
600 ²⁾	630	–	690	–	–	–

¹⁾ This voltage can be the same as the rated voltage of the equipment.
²⁾ These values correspond to the values of table 00.01.
 In countries where both star and delta, earthed and unearthed supply systems are used the values for delta systems only should be used. Systems earthed across impedances are treated as unearthed systems.

Table 00.04

Rated voltage $U_{r.m.s.}$ or U_0 in V	12.5	25	32	50	63	80	100	125	160	200	250	320	400	500	630	800	1000
Minimum creepage distance in mm																	
Degree of pollution 1	0.09	0.125	0.14	0.18	0.2	0.22	0.25	0.28	0.32	0.42	0.56	0.75	1	1.3	1.8	2.4	3.2
Degree of pollution 2	0.42	0.5	0.53	1.2	1.25	1.3	1.4	1.5	1.6	2	2.5	3.2	4	5	6.3	8	10