VDE Information

General Information

The voltage which can be applied to a terminal depends on the relevant regulations, the installation conditions and, of course, the dimensions and insulating materials of the terminal. With regards to DIN VDE regulations, clearances and creepage distances are governed by the most recent edition of DIN VDE 0110 in the following cases:

- if the applicable equipment standard contains a reference to DIN VDE 0110
- if it does not specify any values for clearances and creepage distances
- if there are no standards.

The nominal voltages mentioned in the WECO catalog are referred to an assumed degree of pollution. As a rule, they are classed in voltage category 3 with installation heights of less than 2,000 meters above sea level.

Degree of Pollution, Clearances and Creepage Distances and Insulating Materials

DIN VDE 0110, Part 1, Table 4 (extract), Minimum Creepage Distances

Voltage A.C.rms or D.C	Minimum creepage distances in mm											
	Printed circuits		**Other equipment**									
	Pollution degree			Pollution degree			Pollution degree			Pollution degree		
	1	2	1	2			3			4		
	Material group			Material group			Material group			Material group		
	②	③	②	1	2	3a/3b	1	2	3a/3b	1	2	3a/3b/④
25	0.025	0.04	0.125	0.50	0.50	0.50	1.25	1.25	1.25	1.7	1.7	1.7
32	0.025	0.04	0.140	0.53	0.53	0.53	1.30	1.30	1.30	1.8	1.8	1.8
40	0.025	0.04	0.160	0.56	0.80	1.10	1.40	1.60	1.80	1.9	2.4	3.0
50	0.025	0.04	0.180	0.60	0.85	1.20	1.50	1.70	1.90	2.0	2.5	3.2
63	0.040	0.63	0.200	0.63	0.90	1.25	1.60	1.80	2.00	2.1	2.6	3.4
80	0.063	0.10	0.220	0.67	0.95	1.30	1.70	1.90	2.10	2.2	2.8	3.6
100	0.100	0.16	0.250	0.71	1.00	1.40	1.80	2.00	2.20	2.4	3.0	3.8
125	0.160	0.25	0.280	0.75	1.05	1.50	1.90	2.10	2.40	2.5	3.2	4.0
160	0.250	0.40	0.320	0.80	1.10	1.60	2.00	2.20	2.50	3.2	4.0	5.0
200	0.400	0.63	0.420	1.00	1.40	2.00	2.50	2.80	3.20	4.0	5.0	6.3
250	0.560	1.00	0.560	1.25	1.80	2.50	3.20	3.60	4.00	5.0	6.3	8.0
320	0.750	1.60	0.750	1.60	2.20	3.20	4.00	4.50	5.00	6.3	8.0	10.0
400	1.000	2.00	1.000	2.00	2.80	4.00	5.00	5.60	6.30	8.0	10.0	12.5
500	1.300	2.50	1.300	2.50	3.60	5.00	6.30	7.10	8.0	10.0	12.5	16.0
630	1.800	3.20	1.800	3.20	4.50	6.30	8.00	9.00	10.0	12.5	16.0	20.0
800	2.400	4.00	2.400	4.00	5.60	8.00	10.0	11.0	12.5	16.0	20.0	25.0
1000	3.200	5.00	3.200	5.00	7.10	10.0	12.5	14.0	16.0	20.0	25.0	32.0

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① Material group 1 or 2, 3a, 3b, where likelihood to track is reduced due to conditions of sub clause 10.8.
② Material groups 1, 2, 3a and 3b.
③ Material groups 1, 2, and 3a.
④ Values of creepage distances in this area have not been established. Material group 3b is generally not recommended for application in pollution degree 3 (above 630 V) and in pollution degree 4.

DIN VDE 0110 part 2 specifies how the minimum insulating distances for equipment meeting part 1/01.89, section 1.1, must be selected. Their purpose is to establish adequate clearances and creepage distances ensuring the best possible protection for persons and objects against the effects of electrical voltages or currents and against the consequences of malfunctioning electrical equipment.

DIN VDE 0110, Part 2, Table 1				
Nominal voltage (Vrms) to DIN IEC 38	Preferred series of impulse withstand voltages in V category for installation			
	1	2	3	4
230, 277, 400, 480, 500	1500	2500	4000	6000
400, 690	2500	4000	6000	8000
1000	4000	6000	8000	12000

Ambient influences, the surge voltages to be expected, the nature and design of the insulating materials used and any deterioration in the condition of the insulation during storage, transport and operation are all taken into account.

DIN VDE 0110, Part 1, Table 2a (extract)				
Minimum clearances in air in mm up to 2000 m above sea level				
Rated impulse withstand voltage peak (kV)	Case A (heterogeneous field conditions) No dielectric test required. Pollution degree.			
	1	2	3	4
1.2	0.25	0.25	0.8	1.6
1.5 ①	0.25	0.5	0.8	1.6
2	1	1	1	1.6
2.5 ①	1.5	1.5	1.5	1.6
3	2	2	2	2
4 ①	3	3	3	3
5	4	4	4	4
6 ①	5.5	5.5	5.5	5.5
8 ①	8	8	8	8
10	11	11	11	11
12 ①	14	14	14	14
15	18	8	18	18
① Preferred values used in DIN VDE 0110, part 1, table 1.				

Determination of Clearances in the Table

Minimum clearances for homogeneous and heterogeneous fields are listed in table 2a. The manufacturer must select the minimum clearance in accordance with the rated surge voltage and the degree of pollution. The clearance must never fall below this minimum value at any time during the service life of the electrical equipment. The effects of pollution need only be considered if the position and alignment are such as to make a reduction in the clearance due to dirt deposits, water, etc., probable.

Degrees of Pollution in the Micro-Environment

For the purpose of elevating clearances, the following four degrees of pollution in the micro-environment are established; they are related to open unprotected installations:

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Pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no effect as it only occurs on the inside of, for example, electrical measuring instruments (VDE 0410) or electronic measuring instruments (VDE 044).

Pollution degree 2

Normally, only non conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected, such as in housing, sales and other commercial areas as well as in precision mechanical workshops, laboratories, test shops and medical rooms, etc.

Pollution degree 3

Conductive pollution or dry, non-conductive pollution occurs, which becomes conductive due to condensation which is expected, such as electrical equipment for processing machines (VDE 0113), connection terminals and terminal boards for machines (VDE 0530), transformers low voltage switch-gear (VDE 0660).

Pollution degree 4

The pollution generates persistent conductivity caused by conductive dust or by rain or snow. It occurs, for example, in car roofs and under car equipment for electrical locomotives, streetcars and omnibuses, equipment in machine rooms of electrical standard gauge railroad locomotives and internal combustion-engined railcars.

Comparative Tracking Index (CTI)

The materials are separated into 4 groups by their CTI values, as follows:

- Material group 1
  600 < cti
- Material group 2
  400 < cti < 600
- Material group 3a
  175 < cti < 400
- Material group 3b
  100 < cti < 175

Part 1 of DIN VDE 0110 is essentially a factual adoption of IEC report 664 and 664a.

Connection Cross-Sectional Area

The connection cross-sectional area is the nominal cross-sectional area for which a terminal is constructed and to which the specified voltage and current ratings apply. VDE 0609 is one of the regulations applicable to specifying the cross-sectional area.

VDE 0609 states that clamping points for conductors up to a cross sectional area of 10 mm^2 must permit the conductors to be clamped without special preparation of the conductor(s).

Note: The expression "special preparation" covers soldering of the individual wires of a conductor, using cable lugs and bending etc., but not bending the conductor straight before inserting it into the terminal or twisting a stranded conductor in order to strengthen its end.

Construction and Dimensions of Connection Lines to DIN VDE 0295/5.86 American Wire Gauge

Cross-section	Single-strand	Multi-strand		Fine and Microfine		AWG	Solid Wires			Stranded Wires		
(mm^2)	max. Ø mm	max. Ø mm	min. no. of strands fine	max. Ø mm	No. of strands fine		Ø mm	circular mils	mm^2	Ø mm	circular mils	mm^2
0.50	0.8	1.1	7	1.1	15	20	0.81	1020	0.52	0.97	1111	0.56
0.75	1.0	1.2	7	1.3	22	18	1.02	1620	0.82	1.16	1600	0.82
1	1.25	1.4	7	1.5	29	17	1.15	2050	1.04			
-	-	-	-	-	-	16	1.29	2580	1.31	1.50	2580	1.32
1.5	1.5	1.7	7	1.8	29	15	1.45	3260	1.65			
-	-	-	-	-	-	14	1.63	4110	2.08	1.85	4100	2.09
2.5	1.9	2.2	7	2.6	47	13	1.83	5180	2.63			
-	-	-	-	-	-	12	2.05	6530	3.31	2.41	6500	3.32
4	2.4	2.7	7	3.2	53	11	2.30	8230	4.17			
-	-	-	-	-	-	10	2.59	10400	5.26	2.95	10530	5.37
6	2.9	3.3	7	3.9	80	9	2.91	13100	6.63			
-	-	-	-	-	-	8	3.26	16500	8.37	3.73	16625	8.48
10	3.7	4.2	7	5.1	76	7	3.67	20800	10.56	4.15	20820	10.55
-	-	-	-	-	-	6	4.12	26300	13.30	4.67	26250	13.39
16	4.6	5.3	7	7.8	121	5	4.62	33100	16.77	5.24	33100	16.77
-	-	-	-	-	-	4	5.19	41700	21.15	5.90	41650	21.24
25	-	6.6	7	7.6	190	3	5.83	52600	26.67	6.61	52630	26.67
35	-	7.9	7	9.2	265	2	6.54	66400	33.59	7.42	66150	33.74
-	-	-	-	-	-	1	7.35	83700	42.43	8.33	83706	42.69
50	-	9.1	19	11.0	379	1/0	8.25	106000	53.46	9.35	104640	53.36
70	-	11.0	19	13.1	343	2/0	9.27	133000	67.49	10.52	132300	67.47
-	-	-	-	-	-	3/0	10.40	168000	84.95	11.79	172500	87.98
95	-	12.9	19	15.1	466	4/0	11.08	212000	107.15	13.26	210400	107.30
120	-	14.5	37	17.0	588	5/0				14.62	250000	127.00
150	-	16.2	37	19.0	736	6/0				16.00	300000	152.00
						350				17.30	350000	177.00
185	-	18.0	37	21.0	906	400				18.49	400000	203.00
						450				19.61	450000	228.00
240	-	20.6	61	24.0	11776	500				20.66	500000	253.00

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Current Carrying Capacity

The permissible current load of the clamping points depends not only upon the terminal design, but also upon the application of the terminals.

The corresponding equipment regulations such as VDE 0700 must be taken into consideration.

In general, the terminals are designed for the current loads in accordance with VDE 0100, part 523, dependent upon the nominal cross-sectional area. In the case of terminals for printed circuit boards however, the cross-sectional area of the solder termination is crucial to the amperage, whereby the rated current is specified in accordance with VDE 0100, part 523, table 2, group 3.

Current Loading I_2 of Insulated Conductors and Cables Not Laid Underground at Ambient Temperatures from 30°C / 86°F to VDE 0100 Part 523 – Table 2

Cross-section	Group 1		Group 2		Group 3	
(mm^2)	**Cu A**	**Al A**	**Cu A**	**Al A**	**Cu A**	**Al A**
0.75	-	-	12	-	15	-
1	11	-	15	-	19	-
1.5	15	-	18	-	24	-
2.5	20	15	26	20	32	26
4	25	20	34	27	42	33
6	33	26	44	35	54	42
10	45	36	61	48	73	57
16	61	48	82	64	98	77
25	83	65	108	85	129	103
35	103	81	135	105	158	124
50	132	103	168	132	198	155
70	165	-	207	163	245	193
95	197	-	250	197	292	230
120	235	-	292	230	344	268
150	-	-	335	263	391	310
185	-	-	382	301	448	353
240	-	-	453	357	528	414
300	-	-	504	409	608	479
400	-	-	-	-	726	569
500		-	-	-	830	649

Group 1:
One or more single core conduit conductors, e.g. H07V-U to DIN 57 281.

Group 2:
Multicore conductors, e.g. sheathed conductors, conduit wires, lead sheath conductors, under plaster conductors, flexible conductors.

Group 3:
Single core conductors laid in the open, the conductors being laid with a spacing of at least one conductor diameter, also single core wiring in switchgear and distribution equipment and rail distributers.

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