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facts & DATA

Tables
Technical data
Standards
Explanations
Increased safety "e"

(printed on devices also as "Ex e")

Contents – facts & data

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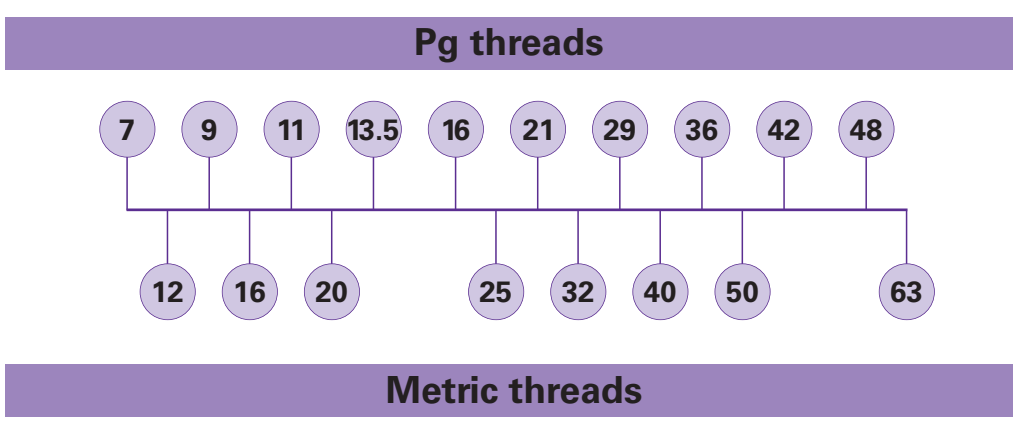
Pg threads are available on request!

1. Basic legal conditions

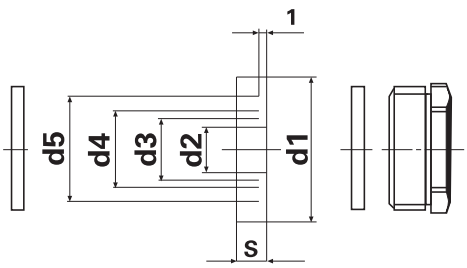
The European standard EN 50 262 "Metric Cable Glands for Electrical Installation" was ratified on April 01, 1989 by CENELEC (European Committee for Electrotechnical Standardization) and put into force.

The main difference in the new EN standard is its character as a security standard. As a building standard it only defines the metric thread and its lead.

2. Comparison of the Pg/metric cable gland sizes



3. Connection range for housing versions 7x.xxx.xxxx.0



Please see the following table for the connection ranges of cable glands without strain relief:

Metric thread	d1	d2	Connection range in mm	d3	Connection range in mm	d4	Connection range in mm	d5	Connection range in mm
M 16	13.8	3	2 – 4.5	6	5 – 7.5	9	8 – 10.5		
M 20	17.6	4	3 – 5.5	7	6 – 8.5	10	9 – 11.5	13	12 – 14.5
M 25	22.6	8.5	7.5 – 10	11.5	10.5 – 13	14.5	13.5 – 16	17.5	16.5 – 19
M 32	29.6	16	15 – 17.5	19	18 – 20.5	22	21 – 23.5	25	24 – 26.5

Maximum short-time current capability assigned to mounting rails

DIN EN 60 947-7-2/VDE 0611 part 3: 1996-06

Rail profile	Material	Equivalent E-Cu cross section mm²	Short-time current capability 1 s kA	Rated thermal current of a PEN busbar A
DIN rail TH 15 – 5.5 according to IEC 60 715	Steel Copper[1)] Aluminum[1)]	10 25 16	1.2 3 1.92	– 101 76
G rail G32 according to IEC 60 715	Steel Copper[1)] Aluminum[1)]	35 120 70	4.2 14.4 8.4	– 269 192
DIN rail TH 35 – 7.5 according to IEC 60 715	Steel Copper[1)] Aluminum[1)]	16 50 35	1.92 6 4.2	– 150 125
DIN rail TH 35 – 15 according to IEC 60 715 (made from 2.3 mm thick material)	Steel Copper[1)] Aluminum[1)]	50 150 95	6 18 11.4	– 309 232

[1)] Selected copper or aluminum alloys from the manufacturer of the terminal block layout were used to achieve the values in the table.

Electrical and thermal characteristics of plastic materials

					Duroplast	Thermoplast							
						Polyamide						Polybutylen-terephtalate	Poly-carbonate
Key figures / characteristics	Standard		Unit		Typ 150	PA 6	PA 6 GF	PA 66	PA 66 GF	PA 66/6	PA 66/6 GF	PBT GF	PC
Dielectric strength	VDE 0303-T21	IEC 243/1	kV / mm	tr/lf.	ca. 10	100 / 60	40 / 31	120 / 80	80 / 65	55 / 45	26 / 23	40	35
Dielectric loss tan _ at 1 MHz	VDE 0303-T4	IEC 250		tr./lf.	0.3	0.03 / 0.3	0.015 / -	0.025 / 0.2	0.02 / 0.1	0.02 / 0.3	0.016 / -	0.017	0.01
Specific feed through resistance	VDE 0303-T30	IEC 93	Ω x cm	lf.	10^{10}	10^{12}	10^{11}	10^{12}	10^{12}	10^{12}	10^{15}	10^{16}	10^{15}
Surface resistance	VDE 0303-T30	IEC 93	Ω	lf.	10^{10}	10^{10}	10^{10}	10^{10}	10^{10}	10^{10}	10^{14}	10^{13}	10^{15}
Creepage	VDE 0303-T1	IEC 112	CTI		600	600	550	600	550	600	325	200	225
Operating temperature RTI*	UL 746 B		°C at 1.5 mm			130	140	125	115	120	140	140	130
Temperature index TI **	VDE 0304 T.21	IEC 216-1	°C		120 / 80	100 / 80	185 / 160	118 / 101	157 / 139	123 / 107		130 / 120	
Lower operating temperature without mechanical stress			°C		-55	-40	-40	-40	-40	-40	-40	-40	-40
Flammability	UL 94		class/material thickness		V0	V2 / 1.5	V2 / 0.8	V2 / 0.4	V0 / 0.8	V0 / 0.4	V0 / 1.5	V0 / 0.5	V0 / 1.04
Suitability for tropical areas					good	good	good	good	good	good	good	good	good

* electrical value

** related to 50% strain resistance drop after 5,000/20,000 hours

Rated connecting capacity and connectable conductor

Table 1 (EN 60 999-1: 2000): **Ratio between rated cross section and diameter of the conductors**

Rated connecting capacity	Theoretical diameter of the largest conductor							Connectable conductor	
	Metric			AWG					
	rigid		flexible	rigid			flexible	rigid	flexible
					b)	b) Class B	c) Class I, K, M		
	solid	stranded			solid	stranded	stranded		
mm^2	mm	mm	mm	Conductor size	mm	mm	mm		
0.2	0.51	0.53	0.61	24	0.54	0.61	0.64	Must be defined in the appropriate product standard.	
0.34	0.63	0.66	0.8	22	0.68	0.71	0.80		
0.5	0.9	1.1	1.1	20	0.85	0.97	1.02		
0.75	1.0	1.2	1.3	18	1.07	1.23	1.28		
1.0	1.2	1.4	1.5	–	–	–	–		
1.5	1.5	1.7	1.8	16	1.35	1.55	1.60		
2.5	1.9	2.2	2.3 a)	14	1.71	1.95	2.08		
4.0	2.4	2.7	2.9 a)	12	2.15	2.45	2.70		
6.0	2.9	3.3	3.9 a)	10	2.72	3.09	3.36		
10.0	3.7	4.2	5.1	8	3.34	3.89	4.32		
16.0	4.6	5.3	6.3	6	4.32	4.91	5.73		
25.0	–	6.6	7.8	4	5.45	6.18	7.26		
35	–	7.9	9.2	2	6.87	7.78	9.02		

NOTE: The diameters of the largest rigid and flexible conductors are taken from table 1 according to IEC 60 228A and IEC 60 344, and for AWG conductors from ASTM B 172-71 [4], ICEA publication S-19-81 [5], ICEA publication S-66-524 [6] and ICEA publication S-66-516 [7].

a) Dimensions only valid for flexible cables of class 5 according to IEC 60 228A.
b) Rated diameter + 5%.
c) Largest diameter for each of the three classes I, K, M, + 5%.

Theoretical diameters of the largest conductor and ratio between the rated cross section and connectable conductors

Table 1 (EN 60 999-2: 2003): **Ratio between rated cross section and diameter of the conductors**

Rated cross section	Theoretical diameter of the largest conductor Metric		Connectable conductor	
	rigid – stranded	flexible[a]	rigid	flexible
mm^2	mm	mm		
50	9.1	11.0	Must be defined in the appropriate product standard.	
70	11.0	13.1		
95	12.9	15.1		
–	–	–		
120	14.5	17.0		
150	16.2	19.0		
185	18.0	21.0		
–	–	–		
240	20.6	24.0		
300	23.1	27.0		

a) Dimensions only valid for flexible conductors of class 5 according to IEC 60 228A.

NOTE: The diameters of the largest rigid and flexible conductors are taken from table 1 and table 3 of IEC 60 228A.

Tables, technical data, wire connections

Facts

Standard cross sections of round copper conductors AWG/metric

Metric size ISO mm²	Comparison between AWG/kcmil and metric sizes		
	AWG	kcmil	mm²
0.1*	28		0.081
0.14*	26		0.128
0.2	24		0.205
–	22		0.324
0.5	20		0.519
0.75	18		0.82
1	–		–
1.5	16		1.3
2.5	14		2.1
4	12		3.3
6	10		5.3
10	8		8.4

Metric size ISO mm²	Comparison between AWG/kcmil and metric sizes		
	AWG	kcmil	mm²
16	6		13.3
25	4		21.2
35	2		33.6
50	(1/0) 0		53.5
70	(2/0) 00		67.4
95	(3/0) 000		85
–	(4/0) 0000		107.2
120		250	127
150		300	152
185		350	177
240		500	253
300		600	304

* not standardized

Design and dimensions of solid, stranded, fine stranded and extra fine stranded copper conductors

Excerpt from DIN VDE 0295 (06.92)

Nominal cross section mm²	solid		stranded		fine stranded	
	Diameter max. size	Number of wires	Diameter max. size	Number of wires	Diameter max. size	Number of wires Guide value
0.5	0.9	1	–	–	1.1	16
0.75	1.0	1	–	–	1.3	24
1	1.2	1	–	–	1.5	32
1.5	1.5	1	–	–	1.8	30
2.5	1.9	1	–	–	2.3	50
4	2.4	1	–	–	2.9	56
6	2.9	1	–	–	3.9	84
10	3.7	1	4.2	7	5.1	80
16	4.6	1	5.3	7	6.3	126
25	–	–	6.6	7	7.8	196
35	–	–	7.9	7	9.2	276
50	–	– –	9.1	19	11	396
70	–	–	11	19	13.1	360
95	–	–	12.9	19	15.1	475
120	–	–	14.5	37	17	608
150	–	–	16.2	37	19	756
185	–	–	18	37	21	925
240	–	–	20.6	61	24	1224

Current carrying capability of cables or wires

The recommended values for current carrying capability of cables or wires for fixed installation and external mounting are to be taken from DIN VDE 0298 sec. 4/08.2003.

Current carrying capacity of DIN rail terminal blocks

The following tables apply for DIN rail terminal blocks and copper conductors:
Test currents according to DIN EN 60 947-7-1/VDE 0611 part 1: 07.2003

Table 4: **Values of the test current for heating, ageing and voltage drop tests for metric conductor sizes**

Rated cross section mm²	0.2	0.34	0.5	0.75	1	1.5	2.5	4	6	10	16
Test current A	4	5	6	9	13.5	17.5	24	32	41	57	76

Rated cross section mm²	25	35	50	70	95	120	150	185	240	300
Test current A	101	125	150	192	232	269	309	353	415	520

The rated cross section of a DIN rail terminal block is the value indicated by the manufacturer of the connectable conductor cross section to which specific thermal, mechanical and electrical requirements refer.

The rated connecting capacity of a DIN rail terminal block is a range and/or a number of rated cross sections that the terminal block is intended for. It should be indicated for each terminal block separately. The conductors can be rigid (solid or stranded) or flexible. The data pertains to unprepared conductor ends without ferrules and includes the largest and smallest connectable conductor cross sections.
In general it is possible to connect two conductors with the same cross section and design.

For DIN rail terminal blocks with special functions, the rated current from the manufacturer has been determined according to the requirements of the special functions. Special functions can be given by pluggable connections, isolating points, fuses, relays or electronic components. The current carrying capacity of other terminal blocks has been fixed and assessed following the above specifications according to EN 60 999/VDE 0609 part 1 or EN 60 998-1/VDE 0613 part 1 or EN 60 335-1/DIN VDE 0700 part 1, as far as they are relevant.

The current carrying capacity for pluggable connectors (catalog sections ***revos*** and ***wiecon*** – for pluggable PC board connectors and headers) has been established and fixed according to DIN EN 61 984/VDE 0627: 09.2002 and DIN EN 175 301-801: 09.2000, if applicable. Disconnect blocks, knife edged disconnect blocks and fuse blocks, cross connectors / jumper bars, jumpers and pluggable connectors should not be operated under load.

Torques of screw connections

Excerpt from EN 60 947-1
Tightening torques for verification of mechanical stability of screw connections

Table 4: **Tightening torques for verification of mechanical stability of screw connections/terminals**

Thread diameter (mm)				Tightening torque (Nm)		
Metric standard values	Diametrical range			I	II	III
1.6	≤ 1.6			0.05	0.1	0.1
2.0	> 1.6	to	2.0	0.1	0.2	0.2
2.5	> 2.0	to	2.8	0.2	0.4	0.4
3.0	> 2.8	to	3.0	0.25	0.5	0.5
–	> 3.0	to	3.2	0.3	0.6	0.6
3.5	> 3.2	to	3.6	0.4	0.8	0.8
4	> 3.6	to	4.1	0.7	1.2	1.2
4.5	> 4.1	to	4.7	0.8	1.8	1.8
5	> 4.7	to	5.3	0.8	2.0	2.0
6	> 5.3	to	6.0	1.2	2.5	3.0
8	> 6.0	to	8.0	2.5	3.5	6.0
10	> 8.0	to	10.0	–	4.0	10.0
12	> 10	to	12	–	–	14.0
14	> 12	to	15	–	–	19.0
16	> 15	to	20	–	–	25.0
20	> 20	to	24	–	–	36.0
24	> 24			–	–	50.0

Column I: Valid only for headless screws, that do not protrude from the threaded hole; also only for screws that are operated with screwdrivers having tips smaller than the screws' thread core diameter.

Column II: applies for nuts and screws that are tightened with a screwdriver.

Column III: applies for nuts and screws that can be tightened with tools other than a screwdriver

The recommended torques were established so that within a conforming practical tolerance band, the optimal conditions are achieved for mechanical, thermal and electrical requirements.

A further increase in the tightening torque of the terminal screw does not improve the contact resistance significantly. It is therefore not advisable to tighten the terminal screws more than recommended, although the majority of the Wieland terminal blocks, especially the terminal blocks of the WK series, can withstand much higher torques.

In extreme cases, the conductor and/or terminal block can be damaged if the upper tolerance limit is exceeded.

Insulation coordination for equipment within low-voltage systems DIN EN 60 664-1 / VDE 0110 part 1: 2003-11 (IEC 60 664-1: 1992 + A1: 2000 + A2: 2002)

Main section 1: General information and terms

1.1 Area of application

1.1.1 This part of IEC 60 664 deals with insulation coordination for equipment within low-voltage systems. It applies to equipment for use up to 2.000 m above sea level, having a rated voltage up to AC 1.000 V with rated frequencies up to 30 kHz or a rated voltage up to DC 1.500 V.

It specifies the requirements for clearances, creepage distances and solid insulation for equipment based upon their performance criteria. It includes methods of electric testing with respect to insulation coordination.

The minimum clearances specified in this part do not apply where ionized gases occur. Special requirements for such situations may be specified at the discretion of the relevant Technical Committee.

This standard does not deal with distances
– through liquid insulation,
– through gases other than air,
– through compressed air.

NOTE 1: Extension of the scope up to 1 MHz is under consideration.
NOTE 2: Higher voltages may exist in internal circuits of the equipment.
NOTE 3: Requirements for altitudes exceeding 2.000 m can be derived from Table A.2 of Annex A.

1.1.2 The object of this basic safety standard is to guide Technical Committees responsible for different equipment in order to rationalize their requirements so that insulation coordination is achieved.

It provides the information necessary to give guidance to Technical Committees when specifying clearances in air, creepage distances and solid insulation for equipment.

Product description and labeling

Currently there is still a range of device specifications, in which the regulations on insulation coordination have still not been incorporated. In addition, transition periods of up to 5 years apply for reworked standards in order to replace the older standards. Thus, for the foreseeable future, there are products existing side by side that have been developed and labeled following the old design rules and those that have already been designed according to the regulations for insulation coordination.

For this reason, wherever possible and applicable, the rating is given in the product descriptions according to the old and new regulations. The reassessment and conversion of the labeling of existing products is selected in the framework of the transition periods in accordance with economical considerations.

Indication of rated values

The rating is given according to the new regulation in the format

Rated voltage/Rated impulse voltage/Degree of pollution
e. g. 800 V/8 kV/3

With this data, the rated impulse voltage is given priority over the overvoltage category. Therefore it is left to the users to decide which overvoltage category to select based on the requirements. If no rated voltage is indicated, the voltage data refer to overvoltage category III and degree of pollution 3.

It is imperative that the indicated wire strip lengths are observed. When connecting the wire, care must be taken that the insulation material is fed as closely as possible to the metal clamping body, as otherwise the creepage distances and clearances might be reduced.

2.2.2.1 Impulse withstand categories (overvoltage categories)

The concept of overvoltage categories is used for equipment energized directly from the mains.

Note: This concept of overvoltage categories is used in IEC 60 364-4-443.

A similar concept can also be used for equipment that is connected to other systems such as telephone or data networks.

2.2.2.1.1 Equipment energized directly from the low-voltage

Technical committees shall specify the overvoltage category on the basis of the following general explanations of overvoltage categories (also see IEC 60 364-4-443):

– Equipment of **overvoltage category IV** is for use at the installation's termination point.

Note: Examples of such equipment are electricity meters and primary surge arresters.

– Equipment of **overvoltage category III** is equipment used in fixed installations and for cases where the reliability and availability of this equipment is subject to special requirements.

Note: Examples of such equipment are switches in fixed installations and equipment for industrial use with permanent connection to this fixed installation.

– Equipment of **overvoltage category II** is power-consuming equipment that is supplied by the fixed installation.

Note: Examples of such equipment are appliances, portable tools and other household or similar devices.

If such equipment is subject to special requirements with regard to reliability and availability, overvoltage category II applies.

– Equipment of **overvoltage category I** is equipment for connection to circuits in which measures are taken to limit transient overvoltages to an appropriate low level.

These measures have to ensure that any possible temporary overvoltages are limited to a degree that the peak values do not exceed the rated impulse voltages as indicated in table 1.

Note 1: Examples of such devices are devices with electronic switching and the corresponding protection level (also see the note under 2.1.1.4).

Note 2: If the power circuits are not designed for temporary overvoltage, devices of overvoltage category 1 cannot be directly connected to the low-voltage network.

2.2.2.1.2 Systems and equipment not directly energized from the low voltage

Technical committees shall specify the suitable overvoltage categories or corresponding rated impulse voltages.
The use of the preferred series under 2.1.1.2 is recommended.

Note: Examples of such systems are telephone or industrial systems, or independent systems in vehicles.

2.5 Pollution

The micro-environment determines the effect of pollution on the insulation. The macro-environment, however, has to be taken into account when considering the micro-environment.

Means may be provided to reduce pollution at the insulation under consideration by effective use of enclosures, encapsulation or hermetic sealing. Such means to reduce pollution may not be effective when the equipment is subject to condensation or if, in normal operation, it generates pollutants itself.

Small clearances can be bridged completely by solid particles, dust and water and therefore minimum clearances are specified where pollution may be present in the micro-environment.

Note 1: Pollution will become conductive in the presence of humidity. Pollution caused by contaminated water, soot, metal or carbon dust is inherently conductive.

Note 2: Conductive pollution by ionized gases and metallic depositions occurs only in specific instances, for example in arc chambers of switchgear or controlgear, and is not covered by this part of IEC 664.

2.5.1 Degrees of pollution in the micro-environment

For the purpose of evaluating creepage distances and clearances, the following four degrees of pollution in the micro-environment are established:

– **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 except that occasionally a temporary conductivity caused by condensation is to be expected.

– **Pollution degree 3**
Conductive pollution occurs or dry, non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.

– **Pollution degree 4**
The pollution generates persistent conductivity caused by conductive dust or by rain or snow.

2.7 Insulation material (excerpt)

The insulation material is divided into the following four groups according to their CTI (Comparative Tracking Index):
Insulation I: $600 \leq CTI$
Insulation II: $400 \leq CTI < 600$
Insulation III a: $175 \leq CTI < 400$
Insulation III b: $100 \leq CTI < 175$
The comparative tracking index must be defined according to IEC 60 112 on specimens made specially for this purpose with test solution A.

Note: The proof-tracking index (PTI) is also used to identify the tracking characteristics of materials. A material may be included in one of the four groups given above on the basis that its PTI, established by the methods of IEC 60 112 using solution A, is equal to or greater than the lower value specified for the group.

Derivation of the rated impulse voltage from the overvoltage category and assignment of the nominal supply voltages to the rated impulse voltages for equipment
DIN EN 60 664-1/VDE 0110 part 1: 11.03 (IEC 60 664-1:1992 + A1:2000 + A2:2002)

Table 1: **Rated impulse voltage for equipment directly energized from the low voltage**

Rated voltage of the power supply system [1] (mains[2] according to IEC 60 038[3]) V		Voltage conductor to neutral conductor derived from the rated AC or DC voltage up to including	Rated impulse voltage[2] V			
			Overvoltage category[4]			
3phase	1phase	V	I	II	III	IV
	120 – 240	50	330	500	800	1500
		100	500	800	1500	2500
		150	800	1500	2500	4000
230/400 277/480		300	1500	2500	4000	6000
400/690		600	2500	4000	6000	8000
1000		1000	4000	6000	8000	12000

[1] See appendix B for applications in other existing low-voltage networks and their rated voltages.

[2] Equipment with this rated impulse voltage may be used in systems according to IEC 60 364-4-443.

[3] The indication with a "/" represents a three-phase 4-wire system. The lower value is the conductor to neutral voltage; the higher value is the conductor to conductor voltage. When only one value is indicated, it refers to three-phase 3-wire systems and represents the conductor to conductor voltage.

[4] For explanation of the overvoltage categories see section 2.2.2.1.1.

Explanations of standards
Insulation coordination

facts

Dimensions of the clearances
DIN EN 60 664-1/VDE 0110 part 1:11.03 (IEC 60 664-1:1992 + A1:2000 + A2:2002)

Table 2: **Clearances for transient overvoltages**

Required impulse voltage [1) 5)]	Minimum clearances for heights over 2000 m above sea level					
	Case A (inhomogeneous field, see 1.3.15)			Case B (homogeneous field, see 1.3.14)		
	Degree of pollution [6)]			Degree of pollution [6)]		
	1	2	3	1	2	3
kV	mm	mm	mm	mm	mm	mm
0.33[2)]	0.01			0.01		
0.40	0.02			0.02		
0.50[2)]	0.04			0.04		
0.60	0.06	0.2[3) 4)]		0.06	0.2[3) 4)]	
0.80[2)]	0.10		0.8[4)]	0.10		
1.0	0.15			0.15		0.8[4)]
1.2	0.25	0.25		0.2		
1.5[2)]	0.5	0.5		0.3	0.3	
2.0	1.0	1.0	1.0	0.45	0.45	
2.5[2)]	1.5	1.5	1.5	0.6	0.6	
3.0	2.0	2.0	2.0	0.8	0.8	
4.0[2)]	3	3	3	1.2	1.2	1.2
5.0	4	4	4	1.5	1.5	1.5
6.0[2)]	5.5	5.5	5.5	2	2	2
8.0[2)]	8	8	8	3	3	3
10	11	11	11	3.5	3.5	3.5
12.[2)]	14	14	14	4.5	4.5	4.5
15	18	18	18	5.5	5.5	5.5
20	25	25	25	8	8	8
25	33	33	33	10	10	10
30	40	40	40	12.5	12.5	12.5
40	60	60	60	17	17	17
50	75	75	75	22	22	22
60	90	90	90	27	27	27
80	130	130	130	35	35	35
100	170	170	170	45	45	45

[1)] This voltage is
– for functional insulation: the highest impulse voltage to be expected on the clearance (see 3.1.4);
– for base insulation directly or essentially influenced by transient overvoltage from the low voltage (see 2.2.2.2, 2.2.2.3.1 and 3.1.5): the equipment's rated impulse voltage;
– for other base insulation (see 2.2.2.3.2): the highest impulse voltage which may occur in the circuit
For reinforced insulation, see 3.1.5.

[2)] Preferred values, as determined in 2.1.1.2

[3)] For PC board connectors, the values of pollution degree 1 apply, except for the fact that the value must not be below 0.04 mm as determined in table 4

[4)] The minimum clearances for pollution degrees 2 and 3 are based on the resistance of the corresponding creepage distances that is reduced due to the influence of humidity (see IEC 60 664-5).

[5)] For components or circuits inside equipment that are loaded with impulse voltages according to 2.2.2.3.2 an interpolation of the values is permissible. By using the preferred series of values according to 2.1.1.2, however, a standardization is achieved.

[6)] The distances for pollution degree 4 match those of pollution degree 3, unless the minimum clearance is 1.6 mm.

Table A.2: **Height correction factors**

Height m	Normal air pressure kPa	Multiplication factor for clearances
2 000	80.0	1.00
3 000	70.0	1.14
4 000	62.0	1.29
5 000	54.0	1.48
6 000	47.0	1.70
7 000	41.0	1.95
8 000	35.5	2.25
9 000	30.5	2.62
10 000	26.5	3.02
15 000	12.0	6.67
20 000	5.5	14.50

Nominal voltage of the low-voltage network DIN EN 60 664/VDE 0110 part 1: 11.03

Table 3a: **Single-phase 3 or 2 wire AC or DC systems**

Nominal voltage of the power supply system (network)*)	Voltages for table 4	
	for insulation Wire – Wire[1)]	for insulation Wire – Ground[1)]
	All systems	3 wire systems center grounded
V	V	V
12.5	12.5	–
24 25	25	–
30	32	–
42 48 50**)	50	–
60	63	–
30–60	63	32
100**)	100	–
110 120	125	–
150**)	160	–
220	250	–
110–220 120–240	250	125
300**)	320	–
220–440	500	250
600**)	630	–
480–960	1000	500
1000**)	1000	–

1) Wire-ground insulation level for ungrounded or impedance-grounded networks equal those of wire-wire, as the operating voltage of each wire to ground can in practice reach wire-wire voltage. The reason is that the actual voltage to ground is determined by the insulation resistance and the capacitive blind resistance of each wire to ground. That means that a low (but permissible) insulation resistance of a wire can practically ground it and increase the other two to wire-wire voltage to ground.

*) For relation with the rated voltage see 2.2.1.

**) These values correspond to the values indicated in table 1.

Table 3b: **Three-phase 4 or 3 wire AC systems**

Nominal voltage of the power supply system (network)*)	Voltages for table 4		
	for insulation Wire – Wire	for insulation Wire – Ground	
	All systems	Three-phase 4 wire systems with grounded neutral[2)]	Three-phase 3 wire systems ungrounded[1)] or grounded wire
V	V	V	V
60	63	32	63
110 120 127	125	80	125
150**)	160	–	160
208	200	125	200
220 230 240	250	160	250
300**)	320	–	320
380 400 415	400	250	400
440	500	250	500
480 500	500	320	500
575	630	400	630
600**)	630	–	630
660 690	630	400	630
720 830	800	500	800
960	1000	630	1000
1000**)	1000	–	1000

1) Wire-ground insulation level for ungrounded or impedance grounded networks equal those of wire-wire, as the operating voltage of each wire to ground can in practice reach wire-wire voltage. The reason is that the actual voltage to ground is determined by the insulation resistance and the capacitive blind resistance of each wire to ground. That means that a low (but permissible) insulation resistance of a wire can practically ground it and increase the other two to wire-wire voltage to ground.

2) For equipment which can be operated both in three-phase 4 wire and in three-phase 3 wire networks, grounded and also ungrounded, only the values for 3 wire systems are to be used.

*) For relation with the rated voltage see 2.2.0.1.

**) These values correspond to the values indicated in table 1.

Explanations of standards
Insulation coordination

facts

Dimensions of the creepage distances

DIN EN 60 664-1/VDE 0110 part 1:11.03 (IEC 60 664-1:1992 + A1:2000 + A2:2002)

Table 4: **Creepage distances used to prevent failure caused by creepage**

Effective voltage value[1]	Minimum creepage distances								
	Printed circuits Pollution degree 1	Printed circuits Pollution degree 2	Pollution degree 1	Pollution degree 2			Pollution degree 3		
	All groups of insulation material	All groups of insulation material, except for IIIb	All groups of insulation material	Insulation material I	Insulation material II	Insulation material III	Insulation material I	Insulation material II	Insulation material III[2]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0.025	0.04	0.08	0.4	0.4	0.4	1	1	1
12.5	0.025	0.04	0.09	0.42	0.42	0.42	1.05	1.05	1.05
16	0.025	0.04	0.1	0.45	0.45	0.45	1.1	1.1	1.1
20	0.025	0.04	0.11	0.48	0.48	0.48	1.2	1.2	1.2
25	0.025	0.04	0.125	0.5	0.5	0.5	1.25	1.25	1.25
32	0.025	0.04	0.14	0.53	0.53	0.53	1.3	1.3	1.3
40	0.025	0.04	0.16	0.56	0.8	1.1	1.4	1.6	1.8
50	0.025	0.04	0.18	0.6	0.85	1.2	1.5	1.7	1.9
63	0.04	0.063	0.2	0.63	0.9	1.25	1.6	1.8	2
80	0.063	0.1	0.22	0.67	0.95	1.3	1.7	1.9	2.1
100	0.1	0.16	0.25	0.71	1	1.4	1.8	2	2.2
125	0.16	0.25	0.28	0.75	1.05	1.5	1.9	2.1	2.4
160	0.25	0.4	0.32	0.8	1.1	1.6	2	2.2	2.5
200	0.4	0.63	0.42	1	1.4	2	2.5	2.8	3.2
250	0.56	1	0.56	1.25	1.8	2.5	3.2	3.6	4
320	0.75	1.6	0.75	1.6	2.2	3.2	4	4.5	5
400	1	2	1	2	2.8	4	5	5.6	6.3
500	1.3	2.5	1.3	2.5	3.6	5	6.3	7.1	8
630	1.8	3.2	1.8	3.2	4.5	6.3	8	9	10
800	2.4	4	2.4	4	5.6	8	10	11	12.5
1000	3.2	5	3.2	5	7.1	10	12.5	14	16
1250			4.2	6.3	9	12.5	16	18	20
1600			5.6	8	11	16	20	22	25
2000			7.5	10	14	20	25	28	32
2500			10	12.5	18	25	32	36	40
3200			12.5	16	22	32	40	45	50
4000			16	20	28	40	50	56	63
5000			20	25	36	50	63	71	80
6300			25	32	45	63	80	90	100
8000			32	40	56	80	100	110	125
10000			40	50	71	100	125	140	160
12500			50 [3]	63 [3]	90 [3]	125 [3]			
16000			63 [3]	80 [3]	110 [3]	160 [3]			
20000			80 [3]	100 [3]	140 [3]	200 [3]			
25000			100 [3]	125 [3]	180 [3]	250 [3]			
32000			125 [3]	160 [3]	220 [3]	320 [3]			
40000			160 [3]	200 [3]	280 [3]	400 [3]			
50000			200 [3]	250 [3]	360 [3]	500 [3]			
63000			250 [3]	320 [3]	450 [3]	600 [3]			

[1] This voltage is

– for functional insulation: the operating voltage

– for base and extra insulation of a power circuit directly supplied by the mains (see 2.2.1.1.1): the voltage selected from table 3a or 3b based on the rated voltage of the equipment, or the rated insulation voltage;

– for base and extra insulation of systems, equipment and internal circuits, which are not directly supplied by the mains (see 2.2.1.1.2): the highest effective voltage value, which may occur among the ratings in the network, equipment or internal circuit under rated voltage supply and under unfavorable combination of the operating conditions

[2] In case of pollution degree 3, insulation material group IIIb is not recommended for use at more than 630 V.

[3] Preliminary indications are based on the extrapolation of existing data. Technical Committees with their own information based on experience may use their own values.

Creepage distances and clearances according to DIN VDE 0110 b/02.79

Reference voltage (table 1) up to		Insulation group A_o		Insulation group A		Insulation group B			Insulation group C			Insulation group D		
Alternating voltage (effective values)	Direct voltage	Clearance	Creepage distance	Clearance	Creepage distance	Clearance	Creepage distance		Clearance	Creepage distance		Clearance	Creepage distance	
V	V	L mm	mm	L mm	mm	L mm	a mm	b mm	L mm	a mm	b mm	L mm	a mm	b mm
12	15	0.06	0.1	0.15	0.2	0.4	0.6	0.8	0.8	1.2	1.7	1.6	2.3	3.2
30	36	0.1	0.15	0.2	0.25	0.5	0.8	1	1	1.5	2	1.8	2.6	3.5
60	75	0.15	0.2	0.25	0.35	0.7	1	1.3	1.2	1.7	2.3	2	3	4
125	150	0.25	0.35	0.4	0.5	1	1.3	2	1.6	2.2	3	2.5	3.5	5
250	300	0.5	0.7	0.8	1	1.6	2	3	2.5	3	4	3.5	5	7.5
380	450	0.8	1.1	1.2	1.5	2.4	3	4	3.5	4.5	6	5	7	10
500	600	1.1	1.5	1.6	2	3	4	5.5	4.5	6	8	6.5	9	13
660	800	1.5	2	2.2	2.8	4	5.5	7	6	8	10.5	8	12	17
750	900	1.8	2.2	2.5	3.2	4.5	6	8	6.5	9	12	9	13	19
1000	1200	2.5	3	3.5	4.5	6	8	11	9	12	16	12	17	25
1500	1800	4	5	5.5	7	9	12	17	13	18	24	17	25	36
2000	2400	5.5[1)]	7	7.5[1)]	9.5	12	16	23	17	24	30	22	33	47
3000	3600	9[1)]	11	12[1)]	15	18[1)]	25	36	26[1)]	36	45	32[1)]	48	70
6000	7200	20[1)]	25	26[1)]	32	36[1)]	50	70	50[1)]	70	90	60[1)]	90	125
10000	12000	35[1)]	45	45[1)]	55	60[1)]	90	120	80[1)]	120	160	100[1)]	150	200

[1)] To prevent continuous glow at operating voltage (reference voltage) sharp-edged metal components should be avoided.
(W. Hermstein: Measuring clearances, especially for 50 Hz alternating voltage.
etz-a 90 (1969) 11, pages 251 to 255, 9B., 11 Qu

Insulation group A_o: Lower-power equipment in air-conditioned or clean and dry rooms that is suitably protected and heats up minimally when short circuits occur

Insulation group A: Electrical equipment in air-conditioned or clean and dry rooms that is suitably protected

Insulation group B: Electrical equipment in households, stores and other commercial premises, in precision engineering workshops, laboratories, testing stations, in rooms for medical use etc.

Insulation group C: Electrical equipment used primarily in premises for industrial, commercial and agricultural use, in unheated warehouses, in workshops, in boiler rooms, machine tools etc.

Insulation group D: Electrical equipment for use in motor vehicles that are particularly subject to the effects of conductive brake dust and moisture (condensation water or snow) and cannot be sufficiently protected by casing.

Division of creepage distances

Table 3: **Resistance to creepage**

1	2	3	4
Group	Resistance to creepage[1)] (minimum value)	Creepage distance without ripple	Creepage distance with ripple according to § 8a)
I	(minimum value) KB 100	b	$\frac{a+b}{2}$
II	(minimum value) KB 380	$\frac{a+b}{2}$	a
III	KB > 600	a	a

[1)] Steps of creepage resistance according to DIN 53 480, VDE 0303 part 1

Note:
The voltages given acoording to DIN VDE 0110 b/02.79 refer, unless otherwise identified, to insulation group C.

Degrees of protection according to DIN EN 60 529/ VDE 0470 part 1: 2000 – 09 (IEC 60 529: 1989, +A1: 1999)

Connecting devices such as modular terminals, connecting terminals, printed circuit board terminals and plug-in connectors etc., intended for mounting devices and installation that have no shock-protection housing in the sense of this standard. No IP protection category can thus be assigned to it. The insulating component is used in the first place for functional insulation, but can in addition offer protection against direct contact of active components e.g. safety finger contact and/or touch by the back of the hand. Its surface is not regarded as exposed. The definitive shock protection is secured by installation measures and by the external protective covering of the end device of the installation.

Identification examples using the IP code

Explanation of Alpha-numeric IP code system

A housing using this identification (IP code)

2 – protects people against access to dangerous components (touch-safe)
– protects the equipment within the housing against ingress of solid foreign bodies with a diameter of 12.5 mm and larger

3 – protects the equipment within the housing against damaging effects of water that is sprayed from every direction against the housing

C – protects people who are handling tools with a diameter of 2.5 mm and larger, and a length less than 100 mm, against access to dangerous components (the tool can be inserted into the housing at full length)

S – is tested to provide protection against damaging effects of water ingress, while all components of the equipment are in standstill position

Components of the IP code and its meaning

A short description of the IP code components is given in the following table:

Component	Figures or letter	Meaning for the protection of the equipment	Meaning for the protection of people:
Identification letter	IP	–	–
First identification number	0 1 2 3 4 5 6	against ingress of solid foreign bodies (unprotected) ≥ 50 mm diameter ≥ 12.5 mm diameter ≥ 2.5 mm diameter ≥ 1.0 mm diameter protected against dust dustproof	against access to dangerous components with (unprotected) back of hand finger tool wire wire wire
Second identification number	0 1 2 3 4 5 6 7 8	against ingress of water with damaging effects (unprotected) dripping water falling vertically dripping water (15° slope) spraying water splashing water jet water powerful jet water temporary submersion continuous submersion	–
Additional character (facultative)	A B C D	–	Against access to hazardous parts with the back of the hand finger tool wire
Supplementary character (facultative)	H M S W	Supplementary information especially for high-voltage devices Movement during underwater test Standstill during underwater test Weather conditions	–

Table 1: **Degrees of protection against access to dangerous components, identified by the first identification number**

First identification number	Degree of protection	
	Brief description	Definition
0	unprotected	–
1	protected against access to dangerous components with the back of the hand	The access probe, 50 mm diameter sphere, must be a sufficient distance away from the dangerous components
2	protected against access to dangerous components with a finger	The jointed test finger, 12 mm in diameter, 80 mm in length, must be a sufficient distance away from the dangerous components
3	protected against access to dangerous components with a tool	The access probe with a diameter of 2.5 mm must not penetrate
4	protected against access to dangerous components with a wire	The access probe with a diameter of 1.0 mm must not penetrate
5	protected against access to dangerous components with a wire	The access probe with a diameter of 1.0 mm must not penetrate
6	protected against access to dangerous components with a wire	The access probe with a diameter of 1.0 mm must not penetrate

Note: For the first identification numbers 3, 4, 5 and 6 protection against access to dangerous components is provided if a sufficient distance is maintained. Due to the simultaneously applicable requirement according to table 2, the definition "must not penetrate" was given in table 1.

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Degrees of protection

Table 2: **Degrees of protection against solid foreign bodies**

First identification number	Degree of protection	
	Brief description	Definition
0	unprotected	–
1	protected against solid foreign bodies of 50 mm and larger	Full penetration of spheres of 50 mm diameters or allowed*)
2	protected against solid foreign bodies of 12.5 mm and larger	Full penetration of spheres of 12.5 mm diameters or allowed*)
3	protected against solid foreign bodies of 2.5 mm and larger	Full penetration of 2.5 mm diameter sphere is not allowed at all*)
4	protected against solid foreign bodies of 1.0 mm and larger	Full penetration of 1.0 mm diameter sphere is not allowed at all*)
5	protected against dust	Penetration of dust is not fully prevented, but dust must not penetrate to such an extent that the satisfactory functioning of the device or safety is restricted in any way
6	protected against dust	No penetration of dust

*) **Note:** The full diameter of the object probe must not go through any opening in the housing

Table 4: **Degrees of protection against access to dangerous components, identified by the additional letter**

First identification number	Degree of protection		Test conditions see section
	Brief description	Definition	
A	protected against touch with the back of hand	The access probe, 50 mm diameter sphere, must be at a sufficient distance away from dangerous components	15.2
B	protected against touch with the finger	The jointed test finger, 12 mm in diameter, 80 mm in length, sufficient distance away from dangerous components	15.2
C	protected against access with a tool	The access probe with a diameter of 2.5 mm and a length of 100 mm must be a sufficient distance away from dangerous components	15.2
D	protected against access with a wire	The access probe with a diameter of 1.0 mm and a length of 100 mm must be a sufficient distance away from dangerous components	15.2

Table 3: **Degree of protection against water, identified by the second identification number**

Second identification number	Degree of protection	
	Brief description	Definition
0	unprotected	–
1	protected against dripping water	Dripping water falling vertically must not have a damaging effect
2	protected against dripping water if the housing is sloped up to 15°	Dripping water falling vertically must not have a damaging effect if the housing is sloped by an angle of up to 15° both sides of the vertical
3	protected against spraying water	Water that is sprayed at an angle of 60° both sides of the vertical must not have any damaging effect
4	protected against splashing water	Water that is sprayed from all directions against the housing must not have any damaging effect
5	protected against jet water	Water that is directed from all directions as a jet against the housing must not have any damaging effect
6	protected against powerful jet water	Water that is directed from all directions as a powerful jet against the housing must not have any damaging effect
7	protected against the effects of temporary immersion in water	Water must not penetrate in a quantity to cause damage if the housing is immersed temporarily in water under standard pressure and time conditions
8	protected against the effects of continuous immersion in water	Water must not penetrate in a quantity to cause damage if the housing is continuously immersed in water conditions that must be arranged between the manufacturer and the user. The conditions must however be more severe than for identification number 7.

Degree of protection against water, identified by the second identification number
The second identification number gives the protection category through housing in light of damaging influences on the electrical equipment following penetration of water.

Table 3 gives short descriptions and definitions for the degrees of protection that are represented by the second identification number.

Degrees of protection that are given in this table may only be determined by the second identification number and not by reference to the short description or definition. Until the second identification number 6, the designation means that the requirements for all the lower identification numbers have been fulfilled.

A housing that is identified only with the second identification number 7 or 8 is considered unsuitable for stress through jet water (identified with the second identification number 5 or 6) and does not need to meet the requirements of number 5 or 6. It should be provided with a double identification according to the following table:

Explanations of standards
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The housing complies with the test for			
jet water, second identification number	temporary/continuous immersion, second identification number	Identification and label	Field of application
5	7	IPX5 / IPX7	varied
6	7	IPX6 / IPX7	varied
5	8	IPX5 / IPX8	varied
6	8	IPX6 / IPX8	varied
	7	IPX7	limited
	8	IPX8	limited

Housings for "varied" use, as indicated in the last column, must meet the requirements both for exposure to jet water and temporary or continuous immersion in water.

Housings for "limited" use, as indicated in the last column, are only regarded as suitable for temporary or continuous immersion and as unsuitable for exposure to jet water.

DIN EN 50 274/VDE 0660 part 514 (previous DIN VDE 0106 part 100: 1983 - 03) Protection against electrical shock. Layout of operating devices near live components

The standard cited in the **Accident Prevention Regulation BGV A3** is seen as the basis for the layout of electrical equipment up to 1000 V ~ (1500 V ⎓) as regards protection against direct contact,where operating devices are arranged near live components that are operated by at least electrotechnically instructed persons (occasional handling).

A protected zone is established for this purpose which must be reached into on "occasional handling" of the operating device (switch, push button, rotary button). A distance of

– 30 mm around the operating device "safety from finger touch" and
– 100 mm around the operating device "safety from touch by the back of the hand"

is designed and required.

The BGV A3 regulation is directed at the installer or user of electrical installations who must plan, build and finally operate the installation in accordance with accident prevention regulations. The installer has the task of selecting electrical equipment with the objective and if necessary making it safe to touch using accessories. Only he can confirm that his installation conforms to the accident prevention regulation BGV A3.

Wieland develops, builds and tests its products according to the relevant equipment and safety regulations that are likewise cited in regulation BGV A3 and moreover offers a range of accessories that takes this requirement into account.

Standards for electrotechnical products

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Range of standards DIN VDE 0100
Installation of power systems and equipment with nominal voltages up to 1000 V.

This VDE regulation is a regulation for installations but also contains important details for the manufacturer of equipment and components such as permissible loads for cables, the use of protective conductor terminals and neutral conductor isolating terminals.

DIN EN 50110-1/VDE 0105 Teil 1: 05.03
Operation of electrical installations

DIN VDE 0108-1/VDE 0108 Teil 1: 10.89
Power installations and safety power supply in communal facilities General

DIN EN 60 664-1/VDE 0110 Teil 1:
Insulation coordination for equipment within low-voltage sysstems
Part 1: Principles, requirements and tests

DIN EN 60 204-1/VDE 0113 Teil 1: 11.98
Safety of machinery – Electrical equipment of machines General requirements

DIN EN 61 140-1/VDE 0140 Teil 1: 08.03
Protection against electric shock Common aspects for installation and equipment

DIN EN 50 178/VDE 0160: 04.98
Electronic equipment for use in power installations

DIN EN 60 079-14/VDE 0165: 07.04
Electrical apparatus for explosive gas atmospheres

DIN EN 60 079-0/VDE 0170/0171 Teil 1: 02.03
Electrical apparatus for explosive gas atmospheres General requirements

DIN EN 60 079-7/VDE 0170/0171 Teil 6: 02.04
Electrical apparatus for potentially explosive atmospheres Increased safety “e”

DIN EN 50 020: VDE 0170/0171 Teil 7: 08.03
Electrical apparatus for potentially explosive atmospheres Intrinsic safety “e”

DIN EN 60 038/VDE 0175: 11.02
IEC standard voltages

DIN EN 60 529/VDE 0470 Teil 1: 09:00
Degrees of protection provided by enclosures (IP Code)

VDE 0606-1/VDE 0606 Teil 1: 10.00
Connecting materials up to 690 V – Installation boxes for accomodation of equipment and/or connecting terminals

VDE 0606-200/A1/VDE 0606 Teil 200/A1
Installation couplers intended for permanent connection in fixed installations

VDE 0606-201/VDE 0606 Teil 201
Installation material intended for permanent coection in fixed installations
Part 201: Electrical connectors for prefabricated components

DIN EN 60 999: VDE 0609 Teil 1: 12.00
Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units General requirements and particular requirements for clamping units for conductors from 0.2 mm^2 up to 35 mm^2 (included)

DIN EN 60 999-2/VDE 0609 Teil 101: 04.04
Connecting devices – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors from 35 mm^2 up to 300 mm^2 (included)

DIN EN 60 947-7-1: VDE 0611 Teil 1: 07.03
Low-voltage switchgear and controlgear Part 7-1:
Ancillary equipment – Terminal blocks for copper conductors

DIN EN 60 947-7-2: VDE 0611 Teil 3: 07.03
Low-voltage switchgear and controlgear Part 7-2:
Ancillary equipment – Protective conductor terminal blocks for copper conductors

DIN VDE 0611-4/VDE 0611 Teil 4: 02.91
Distribution terminal blocks up to 6 mm^2

DIN EN 60 947.-7-3/VDE 0611 Teil 6: 07.03
Low-voltage switchgear and controlgear Part 7-1:
Ancillary equipment – Safety requirements for fuse terminal blocks

DIN VDE 0611-20/VDE 0611 Teil 20: 12.87
Modular terminal blocks for connection of copper conductors up to 1000 V a.c. and up to 1200 V d.c. Test for flammability and flame propagation

DIN EN 60 998-1/VDE 0613-1: 04.94
Connecting devices for low-voltage circuits for household and similar purposes
General requirements

DIN EN 60 998-2-1/VDE 0613 Teil 2-1: 04.94
Connecting devices for low-voltage circuits for household and similar purposes
Particular requirements for connecting devices as separate entities with screw-type clamping units

DIN EN 60 998-2-2/VDE 0613 Teil 2-2: 08.94
Connecting devices for low-voltage circuits for household and similar purposes
Particular requirements for connecting devices as separate entities with screwless-type clamping units

DIN EN 60 998-2-3/VDE 0613 Teil 2-3: 09.94
Connecting devices for low-voltage circuits for household and similar purposes
Particular requirements for connecting devices as separate entities with insulation piercing clamping units

Standards for electrotechnical products

DIN EN 61 210/ VDE 0613 part 6: 09.95
Connecting devices Flat quick-connected terminations for electrical copper conductors; Safety requirements

DIN EN 50 262 / VDE 0619: 09.02
Metric cable glands for electrical installations

DIN EN 60 320-1/ VDE 0625 part 1: 06.02
Appliance couplers for household and similar general purposes General requirements

DIN EN 60 320-2-2/ VDE 0625 part 2-2: 09.99
Appliance couplers for household and similar general purposes Interconnection couplers for household and similar equipment

DIN EN 60 799/ VDE 0626: 06.99
Cord sets and interconnection cord sets

DIN EN 61 984/ VDE 0627: 09.02
Connectors Safety requirements and tests

DIN VDE 0628: 11.84
Connectors for rated voltages up to 380 V a.c. and a rated current of 16 A

DIN EN 60 947-1/VDE 0660 part 100: 01.05
Low-voltage switchgear and controlgear

DIN EN 60 439-1/VDE 0660 part 500: 08.00
Enclosed low-voltage switchgear and controlgear assemblies
Type-tested and partially type-tested assemblies

DIN EN 60 439-3/ VDE 0660 part 504: 05.02
Low-voltage switchgear and controlgear assemblies Particular requirements for low-voltage switchgear and controlgear assemblies intended to be installed in places where unskilled persons have access for their use – Distribution boards –

DIN EN 50 274/Vde 0660 part 514: 11.02
Low-voltage switchgear and controlgear assemblies
Protection against electric shock – Protection against unintentional direct contact with hazardous live parts

DIN EN 60 335-1/ VDE 0700 part 1: 07.03
Safety of household and similar electrical appliances General requirements

EN 60 335-1 A2: 1988, A5: 1989, A6: 1989 and A51: 1991 / DIN VDE 0700 part 1 A6: 12.91
Safety of household and similar electrical appliances
General requirements – Amendments No. 4, 5 and 6 to IEC 60 335-1

Standards for electrotechnical products

facts & DATA

DIN EN 60 598-1/VDE 0711 part 1: 06.01
Luminaires General requirements and tests

DIN EN 60 127-2 / VDE 0820 part 2: 04.04
Miniature fuses

DIN EN 60 127-6 / VDE 0820 part 6: 10.03
Miniature fuses
Fuse-holders for miniature fuse-links

DIN EN 60 512-5-2: 01.03
Connectors for electronic equipment –
Part 5-2: Tests and measurements
Test 5b: Current-carrying capacity tests (current temperature derating)

EN 60 715: 05.01/DIN EN 60 715: 09.01
Dimensions of low –voltage switchgear and controlgear –
Standardized mounting-on rails for mechanical support of electrical devices in switchgear and controlgear installations

DIN EN 175 301-801: 09.00
Detail specification
High density rectangular connectors with round removable crimp contacts

Standards for electronic components

The indicated standards and regulations are considered for the development and manufacturing of our products, as applicable. The installation instructions are also to be followed when installing our products in devices and systems.

DIN EN 50 178/VDE 0160: 04.98
Electronic equipment for use in power installations

EN 50 005: 1976/DIN EN 50 005: 1977-07
Low Voltage Switchgear and Controlgear for Industrial Use;
Terminal Marking and Distinctive Number, General Use

IEC 60 127-2: 2003/EN 60 127-2: 2003/
DIN EN 60 127-2 04.04
Miniature fuses
Part 2: Cartridge fuse-links

IEC 60 255/DIN VDE 0435
Electrical relays

DIN EN 60 529/VDE 0470 part 1: 09.00
(IEC 61 529: 1989 + A1: 1999)
Degrees of protection provided by enclosures (IP Code)

IEC 61 558-1: 07.98/EN 61 558-1: 1997
DIN EN 61 558-1/VDE 0570 part 1: 07.98
Safety of power transformers, power supply units and similar
Part 1: General requirements and tests

DIN EN 60 068-2-1: 1995-03
EN 600 68-2-1: 1993-03
IEC 600 68-2-1: 1990-04
Environmental Testing
Cold Test

DIN EN 60 068-2-2: 1995-03
EN 600 68-2-2: 1993-03
IEC 600 68-2-2:
Environmental Testing
Dry Heat-Test

DIN EN 60 068-2-6: 1996-05
EN 600 68-2-6 : 1995-04
IEC 600 68-2-6: 1995-03
Environmental Testing
Vibration Test

DIN EN 60 068-2-32: 1995-03
EN 600 68-2-32: 1993-04
IEC 600 68-2-32:
Environmental Testing
Free Fall Test

DIN EN 61 131-2/EN 61 131-2/
VDE 0411 part 500 : 2004-02/IEC 61131-2: 2003
Programmable controllers
Equipment requirements and tests

DIN EN 61158-2/EN 61158-2: 2004-07
Digital data communication for measurement and control-Fieldbus for use in industrial control systems
Part 2: Physical layer specification.

IEC 61 000-4-2: 1995 + A1: 1998 + A2: 2001
EN 61 000-4-2: 2001 + A1: 1998 + A2: 2001
DIN EN 61 000-4-2/VDE 0847 part 4-2 (2001-12)
Electromagnetic compatibility (EMC)
part 4-2: Testing and measurement techniques Electrostatic discharge immunity test

IEC 61 000-4-3: 2002 + A1: 2002
EN 61 000-4-3: 2002 + A1: 2002
DIN EN 61 000-4-3/VDE 0847 part 4-3 (2003-11)
Electromagnetic compatibility (EMC)
part 4-3: Testing and measurement techniques Radiated, radio-frequency electro-magnetic field immunity test

IEC 61 000-4-4: 1995 + A1: 2000 + A2: 2001
EN 61 000-4-4: 1995 + A1: 2001 + A2: 2001
DIN EN 61 000-4-4/VDE 0847 part 4-4 (2002-7)
Electromagnetic compatibility (EMC)
part 4-4: Testing and measurement techniques Electrical fast transient/burst immunity test

IEC 61 000-4-5: 1995 + A1: 2000 EN 61 000-4-5: 1995 + A1: 2001
DIN EN 61 000-4-5/VDE 0847 part 4-5 (2001-12)
Electromagnetic compatibility (EMC)
part 4-5: Testing and measurement techniques Surge immunity test

IEC 61 000-4-6: 1996 + A1: 2000
EN 61 000-4-6: 1996 + A1: 2001
DIN EN 61 000-4-6/VDE 0847 part 4-6(2001-12)
Electromagnetic compatibility (EMC)
part 4-6 Testing and measurement techniques Immunity to conducted disturbances , induced by radio-frequency fields

IEC 61 000-4-11 1994 + A1: 2000
EN 61 000-4-11: 1994 + A1: 2001
DIN EN 61 000-4-11/VDE 0847 part 4-11(2001-12)
Electromagnetic compatibility (EMC)
part 4-11: Testing and measurement techniques Voltage dips, short interruptions and voltage variations immunity tests

IEC 61 000-4-14 1999
EN 61 000-4-14: 1999
DIN EN 61 000-4-14/VDE 0847 part 4-14(1999-11)
Electromagnetic compatibility (EMC)
part 4-14: Testing and measurement techniques Voltage fluctuation immunity test

IEC 61 000-3-2: 2000
EN 61 000-3-2: 2000
DIN EN 61 000-3-2/ VDE 0838 part 2 (2001-12)
Electromagnetic compatibility
Limits for harmonic current emissions

IEC 61 000-3-3: 1994 + A1: 2001
EN 61 000-3-3: 1995 + Corrigendum: 1997 + A1: 2001
DIN EN 61 000-3-3/ VDE 0838 part 3 (2001-12)
Electromagnetic compatibility
Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems

Standards for electronic components

IEC 61 000-6-1: 1997
EN 61 000-6-1: 2001
DIN EN 61 000-6-1/ VDE 0839 part 6-1 (2002-8)
Electromagnetic compatibility
Generic standards – Immunity for residential, commercial and light-industrial environments

IEC 61 000-6-2: 1999
EN 61 000-6-2: 2001
DIN EN 61 000-6-2/ VDE 0839 part 6-2 (2002-8)
Electromagnetic compatibility
Generic standards – Immunity for industrial environments

IEC 61 000-6-3: 1996
EN 61 000-6-3: 2001
DIN EN 61 000-6-3/ VDE 0839 part 6-3 (2002-8)
Electromagnetic compatibility
Generic standards – Emission standard for residential, commercial and light industrial environments

IEC 61 000-6-4: 1997
EN 61 000-6-4: 2001
DIN EN 61 000-6-4/ VDE 0839 part 6-4 (2002-8)
Electromagnetic compatibility
Generic standards – Emission standard for industrial environments

IEC /CISPR 11: 1997 + A1: 1999 + A2 : 2002
EN 50 011: 1998 + A1: 1999 + A2: 2002
DIN EN 55011/VDE 0875 part 11 (203-8)
Industrial, scientific and medical (ISM) radio-frequency equipment –
Radio disturbance characteristics – Limits and methods of measurement

IEC /CISPR 22: 1997 + A1: 2000 + A2 : 2002
EN 50 022: 1998 + Corrigendum July 2003 + A1: 2000 + Corrigendum April 2003 + A2 : 2003 + A2: 2002
DIN EN 55022/VDE 0878 part 22
Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement

EN 50 090-2-2: 1996 + Corrigendum 1997
DIN EN 50 090-2-2/VDE 0829 part 2-2 (1997-6)
Home and Building Electronic Systems HBES

UL 94: 1996-10
Tests for flammability of plastic materials for parts in devices and appliances

BGV A3: 1979-04:
Directive 89/336/EWG

COUNCIL DIRECTIVE
of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (89/336/EEC)

Approval and test authorities, test marks and test laboratories

facts & DATA

BVS	BVS	Bergbau Versuchstrecke (DMT), Germany
BSI	BSI	British Standards Institution, Great Britain
	BBJ	Biuro Badawcze ds. Jakosci, Poland
BV	BV	Bureau Veritas, France
	CSA	Canadian Standards Association, Canada
	AU	Chief Electrical Inspector, Victoria, Australia
	AU-DFT	Department of Fair Trading, NSW Consumer Protection Agency, Australia
	CEBEC	Comite Electrotechnique Belge, Belgium
	DEMKO	Danmarks Elektriske Materielkontrol, Denmark
	DNV	Det Norske Veritas, Norway
EPM	EPM	Elektrisches Prüfamt München, Germany
	ESTI	Eidgenössisches Starkstrominspektorat, Switzerland
EIB	EIBA	European Installation Bus Association sc, Belgium
	ELMAC	EMV Labor J. Bühne, Germany
	FIMKO	Electrical Inspectorate, Finnland
	EZU	Electrotechnical Testing Institute, Czech Republic
	GL	Germanischer Lloyd, Germany
	GS	Geprüfte Sicherheit, Germany
	MY-JBP	IBU Pejabat, Jabatan Bomba dan Penyelamat, Malaysia
	IMQ	Instituto Italiano del Marchio di Qualita, Italy
KEMA KEUR	KEMA	Keuring van Elektrotechnische Materialen, Netherlands, KEMA-ATEX
LCIE	LCIE-EEX	Laboratoire Central des Industries Electriques, France
	LGA	Landesgewerbeanstalt Bayern, Germany
LR	LR	Lloyd's Register of Shipping, Great Britain
	MEEI	Magyar Elektrotechnikai Ellenoerzoe Intezet, Hungary
	NEMKO	Norges Elektriske Materiellkontroll, Norway
PS E JET	JET	Japan Electrical Safety & Environment Technology Laboratories
	CCC	CNCA Certification and Accreditation Administration of the People's Republic of China
	ÖVE	Österreichischer Verband für Elektrotechnik, Austria

Approval and test authorities, test marks and test laboratories

PTB	PTB	Physikalisch-Technische Bundesanstalt, Germany
GS	BGFE	Prüf-u. Zert.stelle der Berufsgen. der Feinmech. u. Elektrt., Germany
RINA	RINA	Registro Italiano Navale, Italy
	Belstandart	White Russia
BKI-EEx	BKI-EEx	Robbanasbiztos Villamos Berendezesek Vizsgalo Allomasa, Hungary
GT ME03	GOST R	Russian Federation
SEV	SEV	Schweizerischer Elektrotechnischer Verein, Switzerland
SEV-EEX	SEV-EEX	SEV Ex-Labor „Explosionsschutz“, Switzerland
	SKTC	Slovak Testing Centre, Elektrotechnicky ustav a.s., Slovakia
	SIQ	Slovenian Institute of Quality and Metrology, Slovenia
	MPA	Staatliche Materialprüfungsanstalt Darmstadt, Germany
S	SEMKO	Svenska Elektriska Materielkontrollanstalten, Sweden
TÜV	TÜV	Technischer Überwachungsverein, Germany
ASTA	ASTA	The Association of Short Circuit Testing Authoryties, Great Britain
	Ukrdershst	Ukrdershstandart, Ukraine
UL	ULlist	Underwriters Laboratories Inc.(UL Listed), USA
	ULrec	Underwriters Laboratories Inc.(UL Recogn.), USA
	UTE	Union Technique de l'Electricite, France
VDE	VDE-UG	VDE Gutachten mit Fertigungsüberwachung, Germany
VDE	VDE	Verband Deutscher Elektrotechniker e.V., Germany
	ZIK	Zavod za Ispitivanje Kvalitete robe, Croatia

Test marks of the Agreements on Acceptance of Components

c UR us	C UR US	Underwr. Lab. Inc.(C-UL Recogn.-US), USA/Canada
c UL us	C UL US	Underwr. Lab. Inc.(C-UL Listed-US), USA/Canada
c SP us	C CSA US	Canadian Standard Association (CSA Listed-US), Canada/USA
	CCA	CENELEC CERTIFICATION AGREEMENT
	CB Scheme	IECEE-CB Scheme

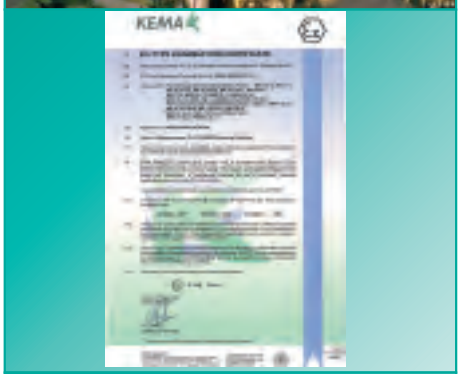
Explanations of applications in hazardous areas
General

facts & DATA

Before 2003-06-30 the Ex protection directive 76/117/EWG applied for the EC and was translated into the relevant national law. For an approximation of the laws of the EU member states, directive 94/9/EG was created, which is generally known as ATEX 100a and which is the basis for harmonization in this field.

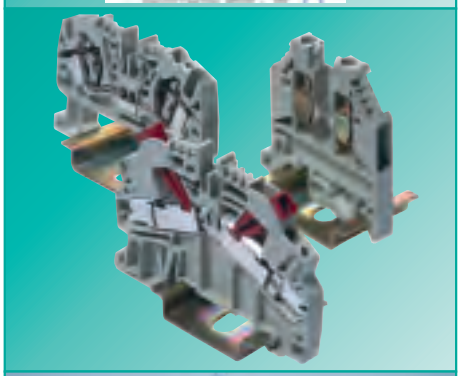
ATEX stands for "atmosphere explosive". When the transition period expires on 2003-06-30, all Ex certificates based on the Ex protection directive 76/117/EC will become invalid. In Ex areas only the ATEX directive will apply then.

For the use of DIN rail terminal blocks in Ex areas with increased safety Ex "e" the regulations EN 60079-0 and EN 60079-7 apply also.



❒ The testing and certifying institutes named in ATEX directive must follow accreditation procedures which are the same throughout Europe.

In accordance with EN 60079-0/-7 and the ATEX directive, these certifying institutes issue EC certificates for prototype tests. These prototype test certificates for components together with the corresponding quality system certification of the supplier are required to obtain the so-called ATEX approval.



❒ DIN rail terminal blocks by **Wieland** with rising cage clamp, spring and IDC connection provide the required protection against self-loosening.

❒ The connector cross sections, rated currents and rated voltages indicated for the terminal blocks in addition to the ATEX identification are part of the certificates.

→ In addition to solid and stranded wires, also fine-stranded wires without ferrules can be connected.

→ The indicated values for the current carrying capability refer to a maximum ambient temperature of 40 °C. When the terminal blocks are loaded with a rated current of +10 %, the maximum heating is 45 K acc. to EN 60079-7:2007.

❒ The ATEX directive applies to protection against dust and gas explosions in all industrial Ex areas as well as in mining.

The **material group** identifies the device's use in specific atmospheres

G: Explosion protection for explosive atmospheres due to gases, vapors or fogs (G:gas)

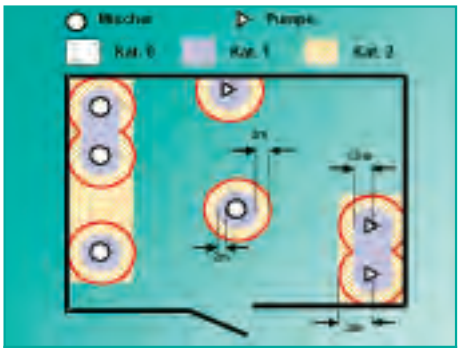
D: Explosion protection for explosive atmospheres due to dusts (D:dust)

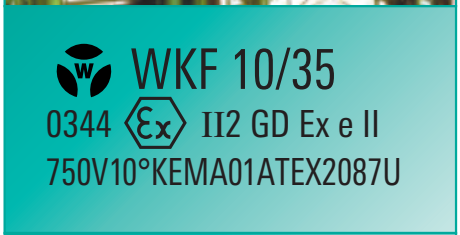
❒ Electrical equipment for hazardous areas are distinguished in **groups** and **categories** depending on the probability of an explosion hazard.

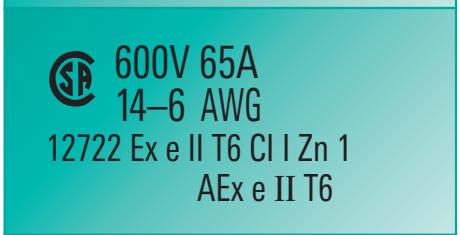
Group I: Equipment for mine openings with firedamp hazard including their bank-head installations

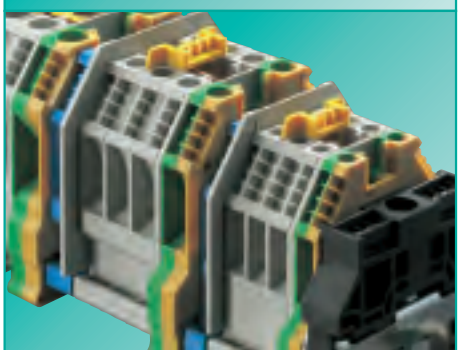
Group II: Equipment installed in all other hazardous areas, especially in the chemical and petrochemical industries.

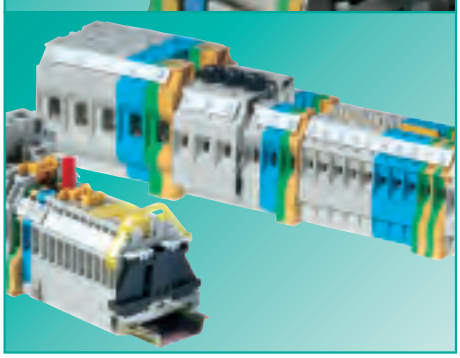
Explanations of applications in hazardous areas
General











The **device category** describes the achieved safety level of the device.

Category 1 Continuous, long-term or frequent occurrence of explosive hazard atmospheres; very high safety degree; explosive gases may occur when the container is empty.

Category 2 Occasional occurrence of explosive hazard atmospheres; high safety degree; especially when machines are operating.

Category 3 Rare or short-term occurrence of explosive hazard atmospheres; normal safety degree; normally only in case of fault.

Hot surfaces of devices or device components are possible sources of ignition and therefore potential hazards. Depending on the maximum surface temperature based on the ignition temperatures of certain gases, temperature classes are assigned to electrical equipment of group II for all types of protection.
DIN rail terminal blocks with protection type "e" for increased safety are normally assigned to **temperature class** T6.

Temperature class	Max. surface temperature [°C]
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Marking of the equipment:

In combination with the Ex mark, the markings of the **Wieland** terminal blocks have the following meaning:

Ex	Ex equipment
II	Device group
2	Category/zone
G D	Material group/areas
Kema	Name of testing institute
ATEX	Year of testing, certificate, consec. no.
U	Certificate valid for components

In addition to the ATEX approval, **Wieland** DIN rail terminal blocks were approved for the indicated Ex areas by the following certificating institutes in North America:

– **UL-AEx, USA**
→ UL increased safety AEx e II T6 for Class I, Zone 1, Group II C hazardous locations

– **CSA-Ex, Canada**
→ Class I, Zone 1, Ex e II T6 for hazardous locations

Mounting instructions for Ex e applications

If feed-through blocks are mounted directly adjacent to other feed-through blocks of a different size, or directly adjacent to ground blocks, the open side of the block group of the same type must be covered by an end plate or partition.

If adjacent DIN rail terminal blocks are jumpered or if jumpered DIN rail terminal blocks are positioned next to unjumpered DIN rail terminal blocks, a partition plate must be inserted between the individual terminal block groups or at the beginning and end of a laterally or longitudinally connected terminal block (group) in order to meet the specified isolation distances. Notched out and jumpering cross connectors can not be used in Ex areas.

Accessories:

The accessories offered by us for the use with DIN rail terminal blocks can be operated according to the ATEX directive and are therefore listed in our catalog.

Ex i design

In Ex i applications (intrinsic circuits) electrical equipment without voltage sources (such as DIN rail terminal blocks) does not require prototype test certificates and marking.

The use of feed-through blocks in blue in intrinsic circuits for clear distinction has become generally accepted. The terminal blocks meet the design of the blocks certified according to Ex e.

DIN rail terminal blocks for installations with explosion hazard (Ex terminals) Protection category Increased safety “e”

Ex terminals are DIN rail terminal blocks that have been tested and certified by a European Ex test institute according to

DIN EN 60079-0, VDE 0170-1: Explosionsfähige Atmosphäre - Teil 0: Geräte - Allgemeine Anforderungen (IEC 60079-0:2007); Deutsche Fassung EN 60079-0:2009 (General requirements)

DIN EN 60079-7, VDE 0170-6: Explosionsfähige Atmosphäre - Teil 7: Geräteschutz durch erhöhte Sicherheit „e“ (IEC 60079-7:2006); Deutsche Fassung EN 60079-7:2007 (Protection category: Increased safety “e“)

The protection category Increased safety “e” applies to electrical equipment that resists sparks, electric arcing or hazardous surface temperatures during operation. DIN rail terminal blocks thus fall into temperature category T6 in which electrical equipment at an ambient temperature of 40 °C and proper use does not exceed the maximum temperature (surface temperature) of 85 °C.

Certifying test institutes are, for example, the Physikalisch Technische Bundesanstalt PTB in Germany, the Laboratoire Central des Industries Electrique LCIE in France, the Health and Safety Executive BASEEFA in Great Britain, the EX laboratory of ASEV in Switzerland, among others.

However, for DIN rail terminal blocks as incomplete electrical equipment, only a partial certification is issued. This certificate is the basis for the final acceptance and certification of the complete installation before it is commissioned by an expert.

The certificate (prototype test certificate) includes a description of the DIN rail terminal blocks, in which special requirements regarding the preparation of terminal strips are put into place, for example, installing partitions and end plates when terminal blocks are connected in series. This information is also provided in our catalog that in this case serves as an instruction manual.

Test Certificate

Certificates of KEMA, PTB and BVS are available for feed-through terminal blocks of series WK.., WKF.., WKC.., WKFN.. and ground blocks of series WK..SL.., WKF..SL.., WKC..SL.., WKFN..SL.. and revos Ex industrial multipole connectors, if indicated. The certificates indicate the relevant rated values and include the accessories listed in the description. The areas of application are divided into:

Group I: Electrical equipment for mine openings with firedamp hazard

Group II: Electrical equipment for hazardous areas except for mine openings with firedamp hazard (for example installations with explosion hazard for the chemical and petrochemical industry).

According to a resolution of the DEK (Deutsche Elektrotechnische Kommission) terminal blocks are also accepted as electrical equipment for Group I (firedamp protection Ex e I) for which only the increased safety protection type “e” for Group II (explosion protection Ex e II) has been certified and vice versa.

Ex protected DIN rail terminal blocks are identified with the marking Ex e I and Ex e II and an additional marking according to ATEX directive 94/9/EG. The complete test certificate with a description is available on request.

Protection category “Intrinsic safety Ex i”

The DIN rail terminal blocks can be used in Group II (Category 2) and Group 1 (Category M2) equipment, as the standard requirements are identical in this case.

It has been generally accepted that feed-through terminals in intrinsic circuits are clearly marked with the blue coloring of the insulated housing. For intrinsic circuits, feed-through terminals can be used in the standard version and if required are available with blue insulating housing.

Explanations of applications in hazardous areas
Industrial multipole connectors

facts

Operating instructions for the connector series “revos Ex…”

A pluggable connection consists of a hood, a base as well as a female and male insert.

Installation of a pluggable connection must be prepared as follows:

– Closed bottom housings must be fixed with screws to a flat surface using the available bore holes.

– Open-bottom housings must be fixed with screws to a flat surface using the available bore holes. Before fixing the housing to the surface, ensure that the seal fixed to the base at the time of delivery is mounted correctly.

– The female insert and male insert must be screwed into the hood (or alternatively screwed into the base) using the screws already attached to the frame of the male or female connector.

– The cables are connected to the male connectors and female connectors using the screw connection with a torque of 0.5 Nm.

The components are made ready for operation by plugging the hood and base together and latching them.

The relevant connectors must be mounted to device in a way that at least protection degree IP 54 according to EN 60 529 is ensured.

The connectors are designed for use in an ambient temperature range at installation site of –20 °C bis +60 °C.

Usage note:

The “revos Ex” plug connector series can be used with a rated voltage of 90 V and a permissible cable cross-section of 0.5 mm^2 to 2.5 mm^2 for the following application areas according to ATEX directive 94/9/EC and the EN 60079-0:2006, EN 60079-11:2007 and EN 50303:2000 standards:

I M1 Ex ia I

Proof is provided by the marking of the Ex area on the individual components of the connector.

Permissible conductor cross section:	1.5 mm^2 to	2.5 mm^2	at	16 A
		1.0 mm^2	at	10 A
		0.75 mm^2	at	6 A
		0.5 mm^2	at	3 A

Wieland Electric GmbH
Brennerstraße 10-14
D-96052 Bamberg
Germany

EXAM
BBG Prüf- und Zertifizier GmbH

Prüfprotokoll - Test and Assessment Report
BVS PP 03.1081 EG

EG - Baumusterprüfung für Geräte und Komponenten zur Verwendung in explosionsgefährdeten Bereichen (Richtlinie 94/9/EG)

EC - Type Examination for Equipment and Components Intended for Use in Potentially Explosive Atmospheres (Directive 94/9/EC)

Gegenstand: Gerät Typ Subject: Equipment type	Steckverbindersatz revos Typ Ex**
Hergestellt und zur Prüfung vorgelegt Manufactured and submitted for examination	Wieland Electric GmbH
Anschrift Address	D - 96052 Bamberg
Prüfgrundlage Basis for examination	Anhang II der Richtlinie 94/9/EG Annex II of Directive 94/9/EC
Verwendete Normen Standard basis	EN 50014:1997+A1+A2 Allgemeine Bestimmungen EN 50020:1994 Eigensicherheit
Prüfgrundlage für Sicherheits- und Gesundheitsanforderungen, die nicht von den verwendeten Normen abgedeckt werden Basis for those health and safety requirements not covered by the standard basis	Entfällt Not relevant
Kennzeichnung Marking	Ex I M2 EEx ia I
Antragsnummer Project number	A 20030062

Seite 1 von 7 zum Prüfprotokoll - Page 1 of 7 of Test Report BVS PP 03.1081 EG

DEKRA

Translation

2nd Supplement

(Supplement in accordance with Directive 94/9/EC Annex III number 6)

to the EC-Type Examination Certificate
BVS 03 ATEX E 184 X

Equipment: **Industrial multipole connectors revos type Ex****

Manufacturer: **Wieland Electric GmbH**

Address: **96052 Bamberg, Germany**

Description

The reason for the issuance of this supplement is to certify the conformity of this equipment with the standard level of EN 60079-0:2006, EN 60079-11:2007 and EN 50303:2000 as well as changing the apparatus category to M1.

The industrial multipole connectors revos type Ex** are rectangular connectors available in a 6-, 10-, 16-, 24-, and 48-pole variant with a screw-type terminal and suitable for a wire range of 0,5 – 2,5mm² which allow to connect single-conductors or fine-wired conductors. The upper and lower section of the enclosures are available in an one hand or two hand interlocking variant and as needed for mounting to an equipment or as a free cable joint.

The connector contains only parts which do not affect the type of protection intrinsic safety. Due to the equipments type of construction the different intrinsically safe circuits are separated up to a sum of voltages (peak values) of 90 V.

The Essential Health and Safety Requirements of the modified equipment are assured by compliance with:

EN 60079-0:2006 General requirements
EN 60079-11:2007 Intrinsic safety "i"
EN 50303:2000 M1 Equipment

The marking of the equipment shall include the following:

Ex I M1 Ex ia I

Page 1 of 3 to BVS 03 ATEX E 184 X / N2
This certificate may only be reproduced in its entirety and without change.
DEKRA EXAM GmbH Dinnendahlstrasse 9 44809 Bochum Germany Phone +49 234/3696-105 Fax +49 234/3696-110 E-mail zs-exam@dekra.com
(until 31.03.2007 EXAM BBG Prüf- und Zertifizier GmbH)