

### Electrotechnical information

#### Voltage grading of connectors (insulation coordination)

Clearances and creepage distances are the base of voltage grading of connectors.

The following standard apply for this:

##### IEC 60664-1

Insulation coordination for equipment within low-voltage systems"

Insulation coordination comprises the selection of the electrical insulation performances of an equipment (e.g. connector), taking into account the expected use and its environment.

Explanation of some terms:

##### – Rated voltage

The value of voltage assigned by the manufacturer to the connector and to which operation and performance characteristics are referred.

##### – Rated impulse voltage

The value of an impulse withstand voltage assigned by the manufacturer to the connector characterising the specified withstand capability of its insulation against transient overvoltages.

##### – Clearance

The shortest distance in air between two conductive parts.

##### – Creepage distance

The shortest distance along the surface of the insulating material between two conductive parts.

##### – Pollution degree

The expected pollution around the equipment (e.g. connector) was established in the standard in four degrees:

###### Pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Examples: The inside of electrical measuring instruments, electronic measuring devices.

###### Pollution degree 2

Only non-conductive pollution occurs. Except that occasionally a temporary conductivity caused by condensation is to be expected.

Examples: Household appliances, installation material, lamps, power supplies of office equipment.

###### Pollution degree 3

Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.

Examples: Electrical equipment of machine tools and processing machines, low voltage switches at machine tools.

###### Pollution degree 4

The pollution generates persistent conductivity caused by conductive dust or by rain or snow.

Examples: Equipment on wagon roofs and beneath wagons at electrical locomotives, rail cars, trolley busses. Equipment at electrical locomotives underground.

###### Additional remarks:

If connectors being defined for pollution degree 1 and overvoltage categorie 1 are applied for other conditions (higher pollution degree and higher overvoltage category), voltage levels reduce correspondingly. But the connectors can be used without any problems at reduced maximum voltages.

It has to be noted that for a connector with a degree of protection of at least IP54 the parts inside the enclosure may be dimensioned for a lower pollution degree. This also applies to mated connectors whose enclosure is ensured through the connector housing and which may only be disengaged for test and maintenance purposes.

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##### – Overvoltage categories

The standard has divided the possible overvoltages into four categories. The three categories which relate to connectors are shortly described below:

##### **Overvoltage category I**

Equipment (e.g. connectors) intended for the use in applications or parts of installations in which no overvoltage can occur. Examples are low voltage equipments.

##### **Overvoltage category II**

Equipment (e.g. connectors) intended for the use in installations or parts of it, in which lightning overvoltages do not need to be considered, however switching overvoltages generated by the equipment. Examples are household appliances.

##### **Overvoltage category III**

Equipment (e.g. connectors) intended for the use in installations or parts of it in which lightning overvoltages do not need to be considered, however switching overvoltages generated by the equipment, and for cases where the reliability and the availability of the equipment (e.g. connectors) or its dependent circuits are subject to special requirements. Examples are protecting means, switches and sockets.

##### –Material groups

For the dimensioning of the creepage distance, the tracking formation of the insulating material used by the manufacturer has to be considered. The materials are separated into three groups according to their CTI values (Comparative Tracking Index):

Material group I  $600 \leq \text{CTI}$

Material group II  $400 \leq \text{CTI} < 600$

Material group III  $175 \leq \text{CTI} < 400$