# IMPORTANT NOTES

Strictly tied to our general conditions of sales

1 ILME designs and manufactures complete solutions for Heavy Duty electrical power connections.
The connector (although offered to the user as a variety of elements, usually inserts and enclosures, to allow the selection of the ideal combination) has been **designed as a complete connector** and tested to be compliant with the essential safety requirements of the EU Low Voltage Directive 2006/95/EC (2014/35/EU from April 20, 2016) and in particular the EN 61984 standard. The design of this "whole" system guarantees that every allowed combination of inserts, enclosures and accessories cannot result as improper.

2 The products in this catalogue alone cannot guarantee the best functionality upon installation, as this depends also on their correct **"putting into service"** which must be performed in compliance with the applicable system safety standards and according to the "rule of the art". Therefore the effectiveness of the installation of the connector depends on the choices of the end user who must also take into account the following safety requirements.

3 Connectors must **not be connected or disconnected when live or under load.**

4 After wiring the inserts it is necessary **to verify the continuity of the protective earth connections.**

5 The **correct coupling of the inserts** is guaranteed only if they are installed (with the four fixing screws supplied *) inside the corresponding enclosures or onto compatible accessories in this catalogue. ILME S.p.A. is not responsible for any different application.

6 Wiring of **screw-type terminal connections** must be carried out applying the correct tightening torque in order to avoid false contacts or damage to the conductor, the screw or the terminal.

7 **Crimping tools** and **crimp contacts** used should preferably be supplied by the same manufacturer to avoid difficulties with the insertion and retention or damaging of the contacts themselves.

8 Correct wiring of **spring-clamp connection inserts** is guaranteed only when the correct screwdriver indicated in the specific catalogue, or possibly on the insert, is used **.

9 Avoid forcing the contacts during **connection and disconnection.** Connectors must be coupled and uncoupled in the axial direction with respect to the contacts, without bending and pulling the attached conductor bundles or cables.

10 Installation of two **inserts side by side,** in enclosures with two bays, must respect the polarity drawing marked on the insert (or the contact side view, as shown in this catalogue) to avoid inverted coupling.

11 Installation of two or more identical **connectors side by side** is recommended only with the use of **coding pins** in order to avoid mismatched couplings.

12 In order to keep the declared **degree of protection** (IP code according to EN 60529, or Enclosure Type Rating according to ANSI/UL 50E), enclosures must be completed with cable glands and/or other accessories with at least an equal degree of protection.

13 Moreover, the declared **degree of protection** (IP code according to EN 60529, or Enclosure Type Rating according to ANSI/UL 50E) is guaranteed when the enclosures, complete with inserts, are coupled and locked with their locking levers (or devices).

14 Connector inserts and their enclosures are generally compatible with similar/equivalent products from other manufacturers, according to the last samples tested. Full compatibility cannot be guaranteed in the event of technical changes made by other manufacturers.
In particular, maximum performance of IP68 enclosures (CG Series) cannot be guaranteed when coupled with other manufacturers' products.

15 **Spare parts** are supplied in minimum quantities only with the purpose to replace damaged parts. To avoid invalidation of warranty, products should be modified or repaired only by ILME: the integrity of their functionality - e.g. their degree of protection - can no longer be guaranteed if products are modified/repaired by end-users. In any case, the liability for correct choice, assembly and use is totally at charge of the installer and the end-user.

16 ILME S.p.A. takes no responsibility in verifying whether the components herein contained comply with any specific regulations of fields of application.

17 ILME cannot be held responsible for individual components in **uses other than those described in this catalogue.**
ILME cannot be held responsible for **incorrect connector selection** in relation to the environmental conditions of the application (e.g.: influence of ambient temperature, moisture, environmental pollution, etc.).

* Except one fixing screw for size "21.21" inserts, two fixing screws for size "32.13" inserts.

** Except for **Squich®** inserts (with spring-clamp terminals with actuator button) that do not require any tool to operate the terminal.

# CE MARKING

As from 1st January 1997, in order to make available electrical products on the European market, the manufacturer must ensure that these bear the relevant **CE marking,** in line with the Low Voltage Directive 73/23/ EEC* (implemented in Italy as L. D. 18-10-1977 no. 791) and its modification 93/68/EEC* (implemented in Italy as L.D. 25-11-1996 no. 626/96, published in the supplement to the Gazzetta Ufficiale of 14-12-1996).

The CE marking must be visible on the product or, if this is not possible, on the packaging, the instructions for use or on the warranty certificate. It acts as a declaration by the manufacturer that the product complies with all relevant EU directives regarding its field of application.

### ILME products bear the CE marking on the actual product or its packaging.

Almost all ILME products fall within the scope of the Low Voltage Directive. An EU declaration of conformity is required in order to be able to apply the CE marking. This declaration, to which the market is not directly entitled, must be made available to the controlling authorities (in Italy, the Ministry of Economic Development) at all times. In it, the manufacturer declares the technical safety standard(s) followed in the design and manufacture of the product. These standards must be, in decreasing order of preference:

— a European standard (EN prefix)
— a European harmonisation document (HD prefix)
— an international IEC standard
— a national standard
— in the absence of reference standards, the manufacturer's internal specifications guaranteeing compliance with the basic safety requirements of the directive.

Conformity with harmonised technical standards (i.e. ratified by CENELEC) also constitutes presumption of conformity with the basic safety requirements of the directives.

The CE marking of ILME products results from the declaration of conformity of the product to harmonised standards or international IEC standards.

Through the CE marking, ILME declares full compliance, not merely with the directive's basic safety requirements, but also with those international or national standards on which voluntary safety certification markings are based (e.g. IMQ and VDE). In this way, ILME intends to give the CE marking the value of self-certification in terms of safety, given the loss in legal value of voluntary certifications issued by third parties, ratified by directive 93/68/EEC*.

Notwithstanding the above, practically all ILME products still bear voluntary conformity markings.

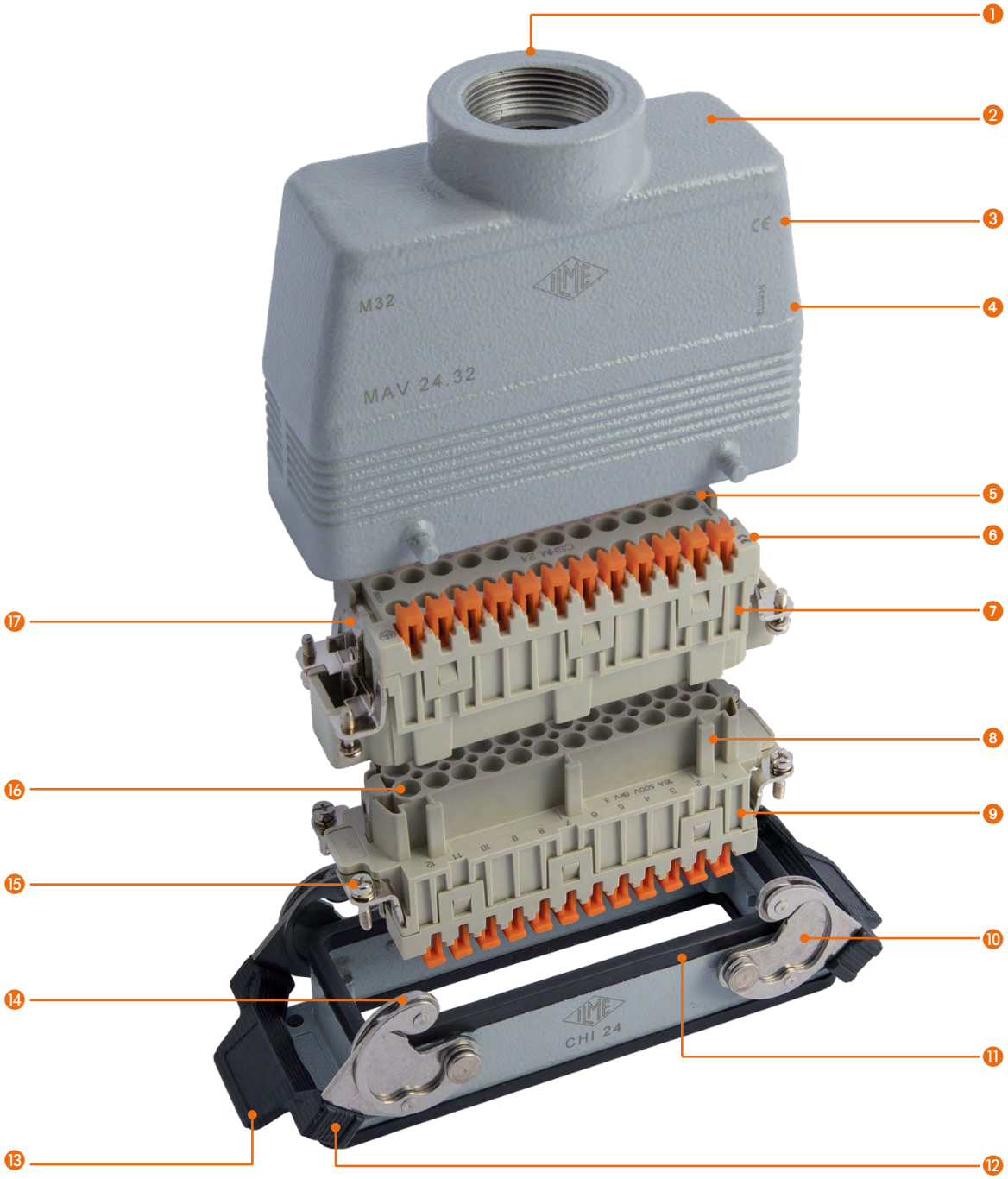
The above mentioned EU declaration of conformity becomes null and void when the assembly of products includes one or more components not manufactured by ILME and without CE marking.

⚠ **The information contained in this catalogue is not binding and may be changed without notice.**

*** Note:** The next legal reference for the Low Voltage Directive was 2006/95/EC, as consolidation of the original Directive 73/23/EEC + Directive 93/68/EEC. On 29th March 2014, the Official Journal of the European Union published the new Low Voltage directive 2014/35/EU dd. 26th February 2014, a recast version of directive 2006/95/EC, which is in force since 20th April 2016.

UNI EN ISO 9001: 2015
Design, manufacture and distribution
of industrial electrical equipment (IAF 19)
Certificate No. 50 100 11133

# GENERAL FEATURES OF MULTIPOLE CONNECTORS



1. **Threaded cable entry** in various Pg diameters (types with pre-code “C”) or metric cable entry (types with pre-code “M”) in accordance with EN 60423, for cable entry devices in accordance with EN 62444 (NPT threading on request), may be located vertically, horizontally or frontally.
2. Rugged die-cast **aluminium alloy** or **zinc alloy** (most of CKA, MKA) or **self-extinguishing thermoplastic** enclosures (types CK, MK, CQ 08 and T-TYPE), c UL us approved.
   Surface-mounting, bulkhead, and hood versions available, with or without hinged cover, or with free protection covers. Enclosure types CH-CA (w/ Pg cable entries) and MH-MA (w/ metric cable entries) have an internal tab that prevents the insertion of higher voltage inserts series CME (all) and CMCE (only 16+2 poles), while CM (Pg) enclosures series and MM (metric) dedicated to those 830 V inserts have no tab and contain supplementary insulating strips inside.
3. **CE marking** attesting conformity to the requirements of the Low Voltage directive (2014/35/EU).
4. Metallic enclosures with a coated **finish** of thermosetting epoxy-polyester (epoxy for W-Type, IP68 CG/MG and E-Xtreme®) with high resistance to mechanical stress and external agents. Enclosures for use at temperatures up to 180 °C are treated with special coatings.
   Where improved electromagnetic shielding is necessary, EMC enclosures treated by highly conductive and corrosion resistant RoHS 2 conform surface treatment.
5. **Contact position** identified with numbers or codes on both sides of each insert and printed with a laser system or by mould.
6. **CE marking** attesting conformity to the requirements of the Low Voltage directive (2014/35/EU).
7. **Inserts** are made of UL certified self-extinguishing fibreglass reinforced thermoplastics, and feature an operating temperature range between -40 °C and +125 °C. The inserts CME (all) and CMCE (only 16+2 poles) for 830V have a key that prevents the insertion of inserts for use other than that prescribed (types CM - Pg and MM - metric). For some series, inserts in PPS (polyphenylene sulphide) may be requested for special uses with temperatures of up to 180 °C.
8. Insert **polarised profiles** with asymmetrical guides to avoid incorrect matings. Inserts have a mechanical life equal to or higher than 500 mating cycles.
9. Inserts and enclosures are manufactured in compliance with European standard **EN 61984** (DIN VDE 0627), certified and identified with **UL** ( c UL us or UL ) and **CSA** marks.
10. Stainless steel **locking levers and springs** guarantee a perfect closure and a tight sealing.
11. Special **sealing gaskets** in vinyl nitrile elastomer, polyurethane or fluoroelastomer (on R-Type enclosures for use with maximum temperatures of 180 °C, on W-Type enclosures for aggressive environments and on E-Xtreme® enclosures for ultimate resistance to corrosion and erosion), anti-aging, oil-resistant, fuel-resistant, together with the cable entry devices (not supplied) provide a degree of protection (IP code per EN IEC 60529 and Enclosure Type Rating per ANSI/UL 50E) for coupled connectors. Special conductive sealing gaskets for S-Type EMC enclosures.
12. **Locking device** available in two versions, simple (with one locking lever), or double (with two locking levers). In metallic enclosures, ILME offers different types of locking levers: vertical (V-Type) or classic (C-Type) rotational closure.
13. Various **handle** solutions are available:
    in self-extinguishing thermoplastic material; in die-cast aluminium, or by stainless steel (either integral or built-in with the lever).
14. **Pins and locking levers** (C-Type as shown in picture) supplied with anti-friction rolls that facilitate closure and limit wear and tear.
15. Captive **insert fastening screws,** with anti-slackening spring washer or under-head knurling.
16. **Silver or gold plated brass contacts** connected to the wires by means of captive screws supplied already slackened (screw-type connectors), with spring-clamp terminal (spring connectors), spring-clamp terminals already open with actuator button (Squich®, as shown in picture), by means of crimping (contacts available separately), or with a built-in 45° terminal block (in turn with screw-type or spring-clamp terminals).
17. Protective **earth terminal** with a wide contact surface.

**Find more information on our products at www.ilme.com**

# Dimensioning of clearances and creepage distances

European standard **EN 61984**:2009 which incorporates without modification the corresponding international standard **IEC 61984** Ed. 2.0 (2008-10) is the reference standard for safety requirements and the relevant tests for multipole connectors for industrial uses.

It is applicable to connectors with rated voltage values of over 50 V, and up to 1 000 V, and rated currents values of up to 125 A per pole, for which no dedicated standard exists, or to which the detail specifications or the manufacturer refer as regards the safety aspects. It can be used as a guide for connectors with rated current exceeding 125 A per pole and for those with a rated voltage up to 50 V (the latter excluded from the scope of the Low Voltage Directive 2014/35/EU).

The last edition of the EN 61984 standard also introduced the definition of **connector without breaking capacity** (COC) to better distinguish this category of products from **connectors with breaking capacity** (CBC).

For the safety and performance requirements of connector terminals, which depend on the connection technology adopted, this standard integrally refers to the corresponding standards (EN IEC 60999 series for screw-type and screwless type terminals, EN IEC 60352 series for solderless connections and relevant terminations).

For determining the minimum clearances and creepage distances (i.e. distances through-air and along the insulating surface) for connectors, this standard now refers, without any modifications to standard **IEC 60664-1** Ed. 2.0 (2007-04)[1].

In the following, the method for determining the minimum insulation in connectors is illustrated with reference to the IEC 60664-1 standard. The rated characteristics of each ILME connector family are provided on pages 14-19. As already in the first edition, the following are now obsolete: the insulation group concept and the distinction of rated voltage values into DC and AC, voltage values 220 V and 380 V were adapted to standardised values 230 V and 400 V according to IEC 60038[2] and some concepts were taken from the regulations for LV electrical systems of the IEC 60364[3] series, such as:

a. the **overvoltage category** (I, II, III, IV), according to the use of the equipment[4]: this is correlated with the transient overvoltages taken as a basis for determining the rated impulse voltage;
b. the **pollution degree** (1, 2, 3);
c. the **material group** (I, II, III) classification of insulating materials according to their resistance to tracking;
d. the **electric field condition** *(homogenous or inhomogeneous)*.

## a. Overvoltage categories (or impulse withstand category)

The overvoltage category of a circuit or of an electrical system is identified by a conventional numeral (from I to IV) based on the limitation or the control of the assumed transient overvoltage values obtained on a circuit or electrical system and depends on the means used to reduce the overvoltages.

**Table F.1** provides the rated impulse voltage for equipment energised directly from the low voltage mains as a function of the rated voltage of the power supply system, of the relevant line-to-neutral voltage and of the overvoltage category.

**TABLE F.1.**
**Rated impulse voltage for equipment powered directly from the low-voltage mains (IEC 60664-1 Ed. 2.0 2008-10)**

| Nominal voltage according to IEC 60038 (CENELEC HD 472 S1, CEI 8-6) | | Voltage line to neutral derived from nominal voltages a.c. or d.c. | Rated impulse voltage [b] Overvoltage category | | | |
|---|---|---|---|---|---|---|
| V | V | ≤ | V | | | |
| Three -phase [a] | Single phase | | I | II | III | IV |
| | | 50 | 330 | 500 | 800 | 1500 |
| | | 100 | 500 | 800 | 1500 | 2500 |
| | 120-240 | 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 |

a) The "/" symbol indicates a four-wire three phase distribution system (star distribution). The lower value is the voltage between phase and neutral (phase voltage), whereas the higher value is the voltage between the phases (mains voltage). Where only one value is indicated, it refers to three-wire, three-phase systems (delta distribution) and specifies the line-to-line value.
b) Equipment with these rated impulse values can be used in installations in accordance with standard IEC 60364-4-443 (Italian standard CEI 64-8/4 Section 443, German DIN VDE 0100-443).

**Industrial machinery and installations with fixed connection to the low voltage supply system, hence their relevant components including multipole connectors, constitute an example of equipment belonging to overvoltage category III.**

Examples of general equipment that comes under overvoltage category II are household electrical appliances, portable tools and other household or similar equipment.
For distribution networks with rated voltage **230/400 V** (star distribution, neutral-earthed) and overvoltage category III (impulse withstand category III), the required rated impulse withstand voltage is **4 kV.**
For distribution networks with rated voltage **400 V** or **500 V** (star distribution without neutral or with unearthed neutral, or delta distribution unearthed or corner-earthed) and overvoltage category III (impulse withstand category III), the required rated impulse withstand voltage is **6 kV.**

## b. Pollution degree

Pollution indicates the presence of any kind of foreign matter, whether solid, liquid or gaseous (ionised gas) that can result in a reduction of dielectric strength or surface resistivity of the insulation. The standard establishes four pollution degrees. The categories are identified by conventional numerals based on the quantity of polluting agents or on the frequency of the phenomenon which determines the reduction of the dielectric strength and/or of the surface resistivity.

**Pollution degree 1**
No pollution or only dry, non-conductive pollution. 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.

1) Endorsed with modifications as European standard EN 60664-1:2007 and published by CENELEC member countries as a national standard: Italian standard CEI EN 60664-1:2008-04 (CEI 109-1), German standard DIN EN 60664-1:2008-01 (VDE 0110-1)
2) EN 60038:2011 (IEC 60038-2009, modified), Italian standard CEI EN 60038:2012-08 (CEI 8-6), German standard DIN EN 60038:2012-04 (VDE 0175-1)
3) Italian standard CEI 64-8, German standard DIN VDE 0100
4) EN 60664-1 clarifies that the term "overvoltage category" is synonymous with "impulse withstand category" used in Clause 443 of IEC 60364-4-44

**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**
Continuous conductivity occurs due to conductive dust, rain or other wet conditions.

**Pollution degree 3 is typical of an industrial environment or similar, while pollution degree 2 is typical of a household or similar environment.**

EN 61984 allows the dimensioning of creepage distances (insulating distances along the surfaces) of connectors installed in enclosures with degree of protection ≥IP54 for the pollution degree immediately below that of the application environment (e.g.: 2 instead of 3).

**Abstract from EN 61984**
***6.19.2.1*** *For a connector with a degree of protection IP54 or higher according to IEC 60529, the insulating parts inside the enclosure may be dimensioned for a lower pollution degree.*
*This lower pollution degree also applies to mated connectors where the enclosure is ensured by the connector housing and which may only be disengaged for test and maintenance purposes.*

One may therefore use connectors installed in housings or enclosures with a degree of protection ≥ IP54, at the rated voltage suitable to pollution degree 2 in industrial applications with pollution degree 3, if, in compliance with EN 61984, the connector coupling is opened only occasionally for test and maintenance purposes. Even in the event of temporary or limited permanence in uncoupled state, a closing cover is recommended in order to guarantee at least the IP54 degree of protection.
However, this does not apply to connectors which remain uncoupled and exposed to an industrial atmosphere for an indefinite period.
It should also be noted that pollution might penetrate inside coupled connectors also from remote parts of the electrical system, e.g. through conduits providing cable entry to the connectors enclosure.
Moreover, connector enclosures are usually supplied without cable entry devices, to let the installer select the most suitable one for its end-use application. The IP degree of protection – or the Type rating according to North American standards – marked or assigned to the connector enclosures is guaranteed only for mated and locked connectors that employ cable entry devices with IP degree and/or Type rating equal or higher than those of the connector enclosures chosen, installed in a workmanlike manner.

**Examples of application for the selection of pollution degree 2 for a connector.**
- Connector on an electric motor controller, which is uncoupled only to replace a faulty motor, also in cases where pollution degree 3 is instead specified for the system.
- Connector on a machine built in modules, which is opened only for transport purposes and which is used only for faster installation and for safer putting into service. One must make sure that the connector has not been polluted during transport. To ensure this has not occurred, protective covers or adequate packing must be used.
- Connector inside a panel with degree of protection ≥ IP54. In this case one may even avoid equipping the connector with an IP54 enclosure.

## c. Material group

The insulating material influences the determination of the minimum creepage distance. It is characterised according to the damage it suffers from the concentrated release of energy during scintillations when a surface leakage current is interrupted due to the drying of the contaminated surface.

The **CTI** (comparative tracking index, index of resistance to surface currents, defined in EN IEC 60112) is assumed as index of the resistance to creep currents of the insulating materials in the presence of atmospheric contaminating agents.

The CTI constitutes the numerical value of the maximum voltage at which a material can resist against 50 drops of an electrolytic test solution without tracking failure, i.e. without failure of insulation due to a progressive formation of conductive paths on the surface and/or within the solid insulating material (causing permanent electric arc between the electrodes of the test equipment) due to the combined effect of electric stress and electrolytic contamination.

Solid insulating materials are classified into four groups:

| | |
|---|---|
| **group I** | **600 ≤ CTI** |
| **group II** | **400 ≤ CTI < 600** |
| **group IIIa** | **175 ≤ CTI < 400** |
| **group IIIb** | **100 ≤ CTI < 175** |

For the purpose of determining the minimum creepage distances, the values for groups IIIa / IIIb (Table F.2, IEC 60664-1) are identical.

**The insulating materials used to manufacture the ILME multipole connectors belong to groups IIIa / IIIb.**

## d. Electric field conditions

Minimum clearance (shortest distance in air between two conductive parts) is determined by Table F.2 of IEC 60664-1, bearing in mind the following influencing factors:

- the rated impulse voltage;
- the electric field condition;
- the altitude: the values specified in Table 2 are valid up to 2 000 m; for higher altitudes, the corrective factors specified in Table F.8 of IEC 60664-1 shall be used;
- the micro-environment.

The shape and arrangement of the conductive parts influence homogeneity of the electric field, hence the clearance able to insulate live parts. Clearances of **case A (inhomogeneous field)** withstand the corresponding impulse voltage under all conditions: clearances not less than those specified in **Table F.2 – case A** can be used irrespective of the shape and arrangement of the conductive parts and without verification by an impulse test.

## 1. Determination of clearances

To determine minimum clearance, the following must be identified in accordance with IEC 60664-1 standard:

a) the rated voltage of the power supply (usually 230/400 V thus a conventional voltage line-to-neutral of 300 V, in star distribution networks with earthed neutral, or 400 V for star networks without neutral, or with unearthed neutral, or in networks with secondary windings of the distribution transformer delta connected, unearthed or corner-earthed and, therefore, with conventional line voltage 600 V);

b) the overvoltage category (usually III).

c) The rated impulse voltage determined from Table B.2 of IEC 60664-1 (usually 4 kV or 6 kV).

d) The electric field condition to which the parts through which the current flows shall be subjected (worst case = inhomogeneous field) and the pollution degree (usually 3).

**EN 61984** requires that the **clearance** be dimensioned according to **IEC 60664-1.** For clearances up to 2 mm, typically for printed circuit board connectors, the reference standard may alternatively be **IEC 60664-5,** to be read in conjunction with IEC 60664-1. The minimum clearance (shortest distance in air between two conductive parts) is therefore given by **Table F.2** of IEC 60664-1, according to the rated impulse voltage derived from **Table B.2** of the same standard, which is part of **Annex B** (informative) **Nominal voltages of supply systems for different modes of overvoltage control.** This table is attributable in particular to devices that do not foresee upstream any overvoltage surge arrester; it represents, therefore the "worst case" and replaces **Table 5** of the previous edition of EN 61984. The rated impulse voltage must be chosen based on the nominal supply voltage and the overvoltage category. The assignment of connectors to a particular overvoltage category (usually **III**) is performed according to the rules of IEC 60664-1.

Here below three important definitions from EN 61984 to consider regarding "voltage":

**rated voltage**
value of voltage assigned by the manufacturer to the connector and to which the operating and performance characteristics are referred

NOTE – A connector may have more than one rated voltage value.

[IEC 60664-1:2007, definition 3.9, modified].

**rated impulse voltage**
impulse withstand voltage assigned by the manufacturer to the connector, characterizing the specified withstand capability of its insulation against transient overvoltages

[IEC 60664-1:2007, 3.9.2, modified].

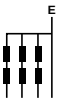
**impulse withstand voltage**
highest peak value of impulse voltage of prescribed form and polarity which does not cause insulation breakdown of insulation under specified conditions

NOTE – The impulse withstand voltage is equal to or higher than the rated impulse voltage

[IEC 60664-1:2007, 3.8.1, modified].

In regard to the choice of the electric field condition, the clearances through possible windows and openings in the insulating material housings, shall comply with the values of Case A of Table F.2 of IEC 60664-1, i.e. for inhomogeneous field conditions.

**TABLE B.2**
Inherent control or control of equivalent protection [IEC 60664-1 Ed.2.0 (2007-04)].

| Voltage line-to-neutral derived from nominal voltages a.c. or d.c. up to and including [1] | Nominal voltages presently used in the world | | | | Rated impulse voltage for the device [1] | | | |
|---|---|---|---|---|---|---|---|---|
| | Three phase four wire systems with earthed neutral  | Three-phase three-wire systems earthed or unearthed  | Single-phase two-wire systems a.c. or d.c.  | Single-phase three-wire systems a.c. or d.c.  | | | | |
| | | | | | Overvoltage category | | | |
| V | V | V | V | V | I | II | III | IV |
| 50 | | | 12,5 24 25 30 42 48 | 30-60 | 330 | 500 | 800 | 1500 |
| 100 | 66/115 | 60 | 60 | | 500 | 800 | 1500 | 2500 |
| 150 | 120/208 *) 127/220 | 115, 120, 127 | 100 **), 110, 120 | 100/-200 *) 110-220 120-240 | 800 | 1500 | 2500 | 4000 |
| 300 | 220/380, 230/400, 240/415, 260/440, 277/480 | 200 **), 220, 230, 240, 260, 277 | 220 | 220-440 | 1500 | 2500 | 4000 | 6000 |
| 600 | 347/600 380/660 400/690 417/720 480/830 | 347, 380, 400, 415, 440, 480, 500, 577, 600 | 480 | 480-960 | 2500 | 4000 | 6000 | 8000 |
| 1000 | | 660 690, 720 830/1000 | 1000 | | 4000 | 6000 | 8000 | 12000 |

1) These columns are taken from Table F.1 indicating the te rated impulse withstand voltages.
*) Used in the United States and Canada.
**) Used in Japan

With the three values (b) (c) and (d) the minimum clearance is determined in Table F.2 IEC 60664-1

**TABLE F.2**

Clearances to withstand transient overvoltages [IEC 60664-1 Ed. 2.0 (2007-04)].

| Required impulse withstand voltage [1) 5)] | Minimum clearances in air up to 2.000 m. above sea level | | | | | |
|---|---|---|---|---|---|---|
| | Case A Inhomogeneous field (see 3.15) Pollution degree [6)] | | | Case B Homogeneous field (see 3.14) Pollution degree [6)] | | |
| | 1 | 2 | 3 | 1 | 2 | 3 |
| kV | mm | mm | mm | mm | mm | mm |
| 0,33 [2)] | 0,01 | 0,2 [3) 4)] | 0,8 [4)] | 0,01 | 0,2 [3) 4)] | 0,8 [4)] |
| 0,4 | 0,02 | | | 0,02 | | |
| 0,50 [2)] | 0,04 | | | 0,04 | | |
| 0,6 | 0,06 | | | 0,06 | | |
| 0,80 [2)] | 0,1 | | | 0,1 | | |
| 1 | 0,15 | | | 0,15 | | |
| 1,2 | 0,25 | 0,25 | | 0,2 | | |
| **1,5** [2)] | 0,5 | 0,5 | | 0,3 | 0,3 | |
| 2 | 1 | 1 | 1 | 0,45 | 0,45 | |
| 2,5 [2)] | 1,5 | 1,5 | 1,5 | 0,6 | 0,6 | |
| 3 | 2 | 2 | 2 | 0,8 | 0,8 | |
| **4,0** [2)] | 3 | 3 | **3** | 1,2 | 1,2 | 1,2 |
| 5 | 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 maximum impulse voltage expected to occur across the clearance (see 5.1.5),
   — for basic insulation directly exposed or significantly influenced by transient overvoltages from the low-voltage mains (see 4.3.3.3, 4.3.3.4.1 and 5.1.6), the rated impulse voltage of the equipment,
   — for other basic insulations (see 4.3.3.4.2), the highest impulse voltage that can occur in the circuit.
   For reinforced insulation see 5.1.6.
2) Preferred values as specified in 4.2.3.
3) For printed wiring material, the values for pollution degree 1 apply except that the value shall not be less than 0,04 mm, as specified in Table F.4.
4) The minimum clearances given for pollution degrees 2 and 3 are based on the reduced withstand characteristics of the associated creepage distance under humidity conditions (see IEC 60664-5).
5) For parts or circuits within equipment subjected to impulse voltages according to 4.3.3.4.2, interpolation of values is allowed. However, standardization is achieved by using the preferred series of impulse voltage values in 4.2.3.
6) The dimensions for pollution degree 4 are as specified for pollution degree 3, except that the minimum clearance is 1,6 mm.

When the clearance is less than the value indicated for case A, an impulse voltage test is required.

Compared to the previous edition of IEC 60664-1, Table F.2 has been modified. In particular: the columns referring to pollution degree 4 have been removed, the definition of this pollution degree has been modified in 4.6.2 to: *"continuous conductivity occurs due to conductive dust, rain or other wet conditions"*, and clearances for pollution degree 4 area as specified for degree of pollution 3, with the exception that the minimum clearance is 1,6 mm.

In 4.6.3 it states: *"The dimensions for creepage distance cannot be specified where permanently conductive pollution is present (pollution degree 4). For temporarily conductive pollution (pollution degree 3), the surface of the insulation may be designed to avoid a continuous path of conductive pollution, e.g. by means of ribs and grooves (see 5.2.2.5 and 5.2.5)".*

**The values in bold are the most common in multipole connectors for industrial purposes.**

If the component fulfils the minimum clearance prescribed for live parts at opposed polarities, it is exempted from the impulse withstand test. This test is run at sea level using increased voltage values in order to take into account rarefied air at high altitude (the prescribed values refer to 2 000 m a.s.l.). However, if this minimum clearance is not fulfilled, passing the test gives one the right to declare the relevant rated impulse voltage. Declaration of the rated impulse voltage is optional according to EN 61984: if the manufacturer declares the rated impulse voltage, the impulse withstand test is necessary as dielectric verification.

Alternatively, a dielectric voltage withstand test at mains frequencies of 50/60 Hz for 60 s (test 4a of IEC 60512) is necessary, but at reduced values compared to the peak values of the impulse test voltages of wave shape standardised at 1,2/50 µs.

For this purpose, standard EN 61984 provides the following cross-reference table:

**TABLE 8**

Test voltages (EN 61984 Ed. 2.0 - 2009-06)

| Rated impulse withstand voltage $\frac{U_{ipm}}{kV}$ | Test voltages | | |
|---|---|---|---|
| | Impulse withstand voltage* kV (1.2/50 µs) | | Withstand voltage (r.m.s. value) kV (50/60 Hz) |
| | at 2000 above sea level | at sea level | |
| 0,5 | 0,5 | 0,55 | 0,37 |
| 0,8 | 0,8 | 0,91 | 0,5 |
| 1,5 | 1,5 | 1,75 | 0,84 |
| 2,5 | 2,5 | 2,95 | 1,39 |
| 4 | 4 | 4,8 | 2,21 |
| 6 | 6 | 7,3 | 3,31 |
| 8 | 8 | 9,8 | 4,26 |
| 12 | 12 | 14,8 | 6,6 |

* If the test laboratory is situated between sea level and an altitude of 2 000 m a.s.l., interpolation of impulse withstand voltage is allowed.

**NOTE:** This table uses the characteristics of an inhomogeneous field, case A of IEC 60664-1 (worst case).

## 2. Determination of minimum creepage distance

For the **minimum creepage distance** (*shortest distance along the surface of a solid insulating material between two conductive parts,* IEC 60664-1 definition 3.3) **IEC 61984** refers to what prescribed by **IEC 60664-1** in **Table F.4.** It is determined according to: rated voltage, pollution degree and insulating material group.

The rated voltage providing access to **Table F.4** (rationalised voltage derived from the nominal voltages at which the connector is deemed to operate) is determined by **Table F.3a** of IEC 60664-1 for single-phase two or three-wire AC or DC systems or **Table F.3b** for three-phase three or four-wire AC systems.

**TABLE F.3a**
Single-phase two or three-wire AC or DC systems
(IEC 60664-1 Ed. 2.0 - 2007-04).

| Rated supply voltage *) | Rationalised voltages for Table F.4 | |
|---|---|---|
| | For insulation phase-phase 1) | For insulation phase-phase 1) |
| | All systems | Three-wire systems with intermediate earth point |
| V | V | V |
| 12,5 | 12,5 | - |
| 24 | 25 | - |
| 25 | 25 | - |
| 30 | 32 | - |
| 42 | 50 | - |
| 48 | 50 | - |
| 50 **) | 50 | - |
| 60 | 63 | - |
| 30-60 | 63 | 32 |
| 100 **) | 100 | - |
| 110 | 125 | - |
| 120 | 125 | - |
| 150 **) | 160 | - |
| 220 | 250 | - |
| 110-220 | 250 | 125 |
| 120-240 | 250 | 125 |
| 300 **) | 320 | - |
| 220-440 | 500 | 250 |
| 600 **) | 630 | - |
| 480-960 | 1000 | 500 |
| 1000 **) | 1000 | - |

1) The line-to-earth insulation level for unearthed or impedance-earthed lines is equal to that between lines (phases), because the operating voltage of any line (phase) can, in practice, approach full voltage between lines (phases) [line voltage]. This is because the actual voltage to earth is determined by the insulation resistance and by the capacitive reactance of each line-to-earth. Consequently, a low (but acceptable) insulation resistance of a line can, in effect, earth it and increase voltage to earth of the other two phases at full voltage between the lines [line voltage].
2) For equipment for use on both three-phase three-wire and three-phase four-wire AC systems, earthed or unearthed, use only the values for three-wire systems.

*) It is assumed that the rated voltage of the equipment is not less than this value.
**) These values correspond to the values given in Table F.1.

Usually for three-phase systems with 230/400 V nominal voltage, the conventional line-to-line insulation voltage is 400 V and the line-to-earth for TT or TN systems is 250 V.

For three-phase systems with 400 V or 500 V nominal voltage, the conventional line-to-line insulation voltage is respectively 400 V and 500 V.

The pollution degree must be specified according to IEC 60664-1.

This strongly influences the **rated insulation voltage** of a connector. Therefore, the rated insulation voltage of a connector should be reconsidered time by time for each pollution degree.

**TABLE F.3b**
Three-phase four or three-wire AC systems
(IEC 60664-1 Ed. 2.0 - 2007-04).

| Rated supply voltage *) | Rationalised voltages for Table F.4 | | |
|---|---|---|---|
| | For insulation phase-phase 1) | For insulation phase-phase 1) | |
| | All systems | Four-wire three-phase systems with earthed neutral | Four-wire three-phase systems unearthed 1) or with earthed phase |
| V | V | V | V |
| 63 | 63 | 32 | 63 |
| 110 | 125 | 80 | 125 |
| 120 | 125 | 80 | 125 |
| 127 | 125 | 80 | 125 |
| 150 **) | 160 | - | 160 |
| 208 | 200 | 125 | 200 |
| 220 | 250 | 160 | 250 |
| 230 | 250 | 160 | 250 |
| 240 | 250 | 160 | 250 |
| 300 **) | 320 | - | 320 |
| 380 | 400 | 250 | 400 |
| 400 | 400 | 250 | 400 |
| 415 | 400 | 250 | 400 |
| 440 | 500 | 250 | 500 |
| 480 | 500 | 320 | 500 |
| 500 | 500 | 320 | 500 |
| 575 | 630 | 400 | 630 |
| 600 **) | 630 | - | 630 |
| 660 | 630 | 400 | 630 |
| 690 | 630 | 400 | 630 |
| 720 | 800 | 500 | 800 |
| 830 | 800 | 500 | 800 |
| 960 | 1000 | 630 | 1000 |
| 1000 **) | 1000 | - | 1000 |

With this rationalized voltage value, the pollution degree and the material group the minimum creepage distance can be determined using **Table F.4.**

**TABLE F.4**
Creepage distances to avoid failure due to tracking
[IEC 60664-1 Ed.2.0 (2007-04)].

| Effective voltage [1] | Minimum creepage distances | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Materials for printed circuits | | Pollution degree | | | | | | |
| V | 1 | 2 | 1 | 2 | | | 3 | | |
| | All material groups | All material groups except IIIb | All material groups | Material group I | Material group II | Material group III | Material group I | Material group II | Material group III [2] |
| V | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| 10 | 0,0250 | 0,040 | 0,080 | 0,400 | 0,400 | 0,400 | 1,000 | 1,000 | 1,000 |
| 12.5 | 0,0250 | 0,040 | 0,090 | 0,420 | 0,420 | 0,420 | 1,050 | 1,050 | 1,050 |
| 16 | 0,0250 | 0,040 | 0,100 | 0,450 | 0,450 | 0,450 | 1,100 | 1,100 | 1,100 |
| 20 | 0,0250 | 0,040 | 0,110 | 0,480 | 0,480 | 0,480 | 1,200 | 1,200 | 1,200 |
| 25 | 0,0250 | 0,040 | 0,125 | 0,500 | 0,500 | 0,500 | 1,250 | 1,250 | 1,250 |
| 32 | 0,0250 | 0,040 | 0,14 | 0,53 | 0,53 | 0,53 | 1,30 | 1,30 | 1,30 |
| 40 | 0,0250 | 0,040 | 0,16 | 0,56 | 0,80 | 1,10 | 1,40 | 1,60 | 1,80 |
| **50** | 0,0250 | 0,040 | 0,18 | 0,60 | 0,85 | 1,20 | 1,50 | 1,70 | 1,90 |
| 63 | 0,0400 | 0,063 | 0,20 | 0,63 | 0,90 | 1,25 | 1,60 | 1,80 | 2,00 |
| 80 | 0,0630 | 0,100 | 0,22 | 0,67 | 0,95 | 1,30 | 1,70 | 1,90 | 2,10 |
| **100** | 0,1000 | 0,160 | 0,25 | 0,71 | 1,00 | 1,40 | 1,80 | 2,00 | 2,20 |
| 125 | 0,1600 | 0,250 | 0,28 | 0,75 | 1,05 | 1,50 | 1,90 | 2,10 | 2,40 |
| **160** | 0,2500 | 0,400 | 0,32 | 0,80 | 1,10 | 1,60 | 2,00 | 2,20 | 2,50 |
| 200 | 0,4000 | 0,630 | 0,42 | 1,00 | 1,40 | 2,00 | 2,50 | 2,80 | 3,20 |
| **250** | 0,5600 | 1,000 | 0,56 | 1,25 | 1,80 | 2,50 | 3,20 | 3,60 | 4,00 |
| 320 | 0,75 | 1,6 | 0,75 | 1,60 | 2,20 | 3,20 | 4,00 | 4,50 | 5,00 |
| **400** | 1,0 | 2,0 | 1,0 | 2,0 | 2,8 | 4,0 | 5,0 | 5,6 | 6,3 |
| **500** | 1,3 | 2,5 | 1,3 | 2,5 | 3,6 | 5,0 | 6,3 | 7,1 | 8,0 (7,9) [4] |
| **630** | 1,8 | 3,2 | 1,8 | 3,2 | 4,5 | 6,3 | 8,0 (7,9) [4] | 9,0 (8,4) [4] | 10,0 (9,0) [4] |
| **800** | 2,4 | 4,0 | 2,4 | 4,0 | 5,6 | 8,0 | 10,0 (9,0) [4] | 11,0 (9,6) [4] | 12,5 (10,2) [4] |
| **1.000** | 3,2 | 5,0 | 3,2 | 5,0 | 7,1 | 10,0 | 12,5 (10,2) [4] | 14,0 (11,2) [4] | 16,0 (12,8) [4] |
| 1.250 | | | 4,2 | 6,3 | 9,0 | 12,5 | 16,0 (12,8) [4] | 18,0 (14,4) [4] | 20,0 (16,0) [4] |
| 1.600 | | | 5,6 | 8,0 | 11,0 | 16,0 | 20,0 (16,0) [4] | 22,0 (17,6) [4] | 25,0 (20,0) [4] |
| 2.000 | | | 7,5 | 10,0 | 14,0 | 20,0 | 25,0 (20,0) [4] | 28,0 (22,4) [4] | 32,0 (25,6) [4] |
| 2.500 | | | 10,0 | 12,5 | 18,0 | 25,0 | 32,0 (25,6) [4] | 36,0 (28,8) [4] | 40,0 (32,0) [4] |
| 3.200 | | | 12,5 | 16,0 | 22,0 | 32,0 | 40,0 (32,0) [4] | 45,0 (36,0) [4] | 50,0 (40,0) [4] |
| 4.000 | | | 16,0 | 20,0 | 28,0 | 40,0 | 50,0 (40,0) [4] | 56,0 (44,8) [4] | 63,0 (50,4) [4] |
| 5.000 | | | 20,0 | 25,0 | 36,0 | 50,0 | 63,0 (50,4) [4] | 90,0 (56,8) [4] | 100,0 (64,0) [4] |
| 6.300 | | | 25,0 | 32,0 | 45,0 | 63,0 | 80,0 (64,0) [4] | 110,0 (72,0) [4] | 125,0 (80,0) [4] |
| 8.000 | | | 32,0 | 40,0 | 56,0 | 80,0 | 100,0 (80,0) [4] | 140,0 (88,0) [4] | 160,0 (100,0) [4] |
| 10.000 | | | 40,0 | 50,0 | 71,0 | 100,0 | 125,0 (100,0) [4] | 140,0 (112,0) [4] | 160,0 (128,0) [4] |
| 12.500 | | | 50,0 [3] | 63,0 [3] | 90,0 [3] | 125,0 [3] | | | |
| 16.000 | | | 63,0 [3] | 80,0 [3] | 110,0 [3] | 160,0 [3] | | | |
| 20.000 | | | 80,0 [3] | 10,0 [3] | 140,0 [3] | 200,0 [3] | | | |
| 25.000 | | | 10,0 [3] | 125,0 [3] | 180,0 [3] | 250,0 [3] | | | |
| 32.000 | | | 125,0 [3] | 160,0 [3] | 220,0 [3] | 320,0 [3] | | | |
| 40.000 | | | 160,0 [3] | 200,0 [3] | 280,0 [3] | 400,0 [3] | | | |
| 50.000 | | | 200,0 [3] | 250,0 [3] | 360,0 [3] | 500,0 [3] | | | |
| 63.000 | | | 250,0 [3] | 320,0 [3] | 450,0 [3] | 600,0 [3] | | | |

1) This voltage is
- for functional insulation, the working voltage,
- for basic and supplementary insulation of the circuit energized directly from the supply mains (see 4.3.2.2.1), the voltage rationalized through Table F.3a or Table F.3b, based on the rated voltage of the equipment, or the rated insulation voltage,
- for basic and supplementary insulation of systems, equipment and internal circuits not energized directly from the mains (see 4.3.2.2.2), the highest r.m.s. voltage which can occur in the system, equipment or internal circuit when supplied at rated voltage and under the most onerous combination of conditions of operation within equipment rating.

2) Material group IIIb is not recommended for application in pollution degree 3 above 630 V.
3) Provisional data based on extrapolation. Technical committees who have other information based on experience may use their dimensions.
4) The values given in brackets may be applied to reduce the creepage distance in case of using a rib (see 5.2.5).
**NOTE** – The high precision used in indicating creepage distances in this table does not mean that the uncertainty of measurement has to be of the same order of magnitude.

In **boldface** the typical values for multipole rectangular connectors for industrial uses are shown.

# EU environmental legislation

## RoHS 2 (2011/65/EU) and WEEE 2 (2012/19/EU) Directives

The **RoHS 2 2011/65/EU Directive** (recast) replaced on 2013-01-03 the original RoHS 2002/95/EC Directive (with its later amendment 2008/35/EC).

This Directive introduced the ban of use of certain hazardous substances in new electrical and electronic equipment (end products) placed on the market from 1st of July 2006 (the exceptions for some applications were listed in Annex of the Directive and in a number of further Decisions of the EU Commission). Indirectly – in the supply chain – the ban also applied to the electrical components of said electrical and electronic equipment.

The banned and/or restricted substances originally were:

**Lead** (Pb) (0,1 %), **Mercury** (Hg) (0,1 %), **Cadmium** (Cd) (0,01 %), **Hexavalent Chromium** ($Cr^{6+}$) (0,1 %), **Poly-brominated biphenyls** (PBB) (0,1 %) and **Poly-brominated diphenyl ethers** (PBDE) (0,1 %) (the latter two being families of flame retardants for thermoplastic materials)

to which the **Commission Delegated Directive 2015/863/EU** of 2015-03-31 added – with a period of grace of six and a half years – the following ones:

**Bis(2-ethylhexyl) phthalate** (DEHP) (0,1 %), **Butyl benzyl phthalate** (BBP) (0,1 %), **Dibutyl phthalate** (DBP) (0,1 %), **Diisobutyl phthalate** (DIBP) (0,1 %).

All ILME finished products (industrial electrical equipment) as well as all ILME components (for industrial electrical equipment) in the sense of the Directive are in conformity with the **RoHS 2 2011/65/EU Directive and all subsequent modifications** within the terms of its scope and the starting dates (transitional periods) established for each category of EEE (electrical and electronic equipment) covered in Annex I of said Directive.

For all components (connector inserts, removable crimp contacts, enclosures for connectors, and accessories related to connectors as far as they are in the scope) the products comply with the limit values for certain substances as set out in said RoHS 2 2011/65/EU Directive and all subsequent modifications, including the permitted exemptions of Annexes III and IV.

Conformity to Directive 2011/65/EU (RoHS II) is intended to the text of the Directive as amended by any applicable later Directive or Commission Delegated Directive associated to it and issued up to the date of this Catalogue (54 documents plus 2 Corrigenda) and to the extent described in the text of this Declaration, including these notes.

Depending on the product, it may make use of exemption 6(b) for lead as an alloying element in aluminium containing up to 0,4% lead by weight (enclosures for multi-pole electrical connectors declared to be made by aluminium die cast alloy, except IP68 series of sizes "44.27" through "104.27" and E-Xtreme® series, which do not use such exemption) or exemption 6(c) for copper alloy containing up to 4% lead by weight (multi-pole connector inserts and removable crimp contacts, except CSH S series, which does not use such exemption as it is not using machined contacts).

NOTE 1 – Expiration of exemption 6(b) has been deferred to 21st July 2021 for our category of products by Commission Delegated Directive (EU) 2018/740; expiration of exemption 6(c) has been deferred to 21st July 2021 for our category of products by Commission Delegated Directive (EU) 2018/741. The above expirations may be subject to further deferment, based on a public enquiry procedure deemed to start on 1st January 2021.
NOTE 2 – Such products by themselves – as components – are not covered by the RoHS 2 Directive; therefore, for such products, there are no direct legal requirements. As no EU Declaration of Conformity can be issued, the above does not constitute a EU Declaration of Conformity to the RoHS 2 2011/65/EU Directive, and the CE marking – which may be applied either on the part or on the packaging label in compliance with other applicable EU Directives, e.g. the Low Voltage Directive 2014/35/EU (a recasting of the previous directive 2006/95/EC in force from 2016-04-20) – is not referred to said RoHS 2 Directive.

The **WEEE 2 2012/19/EU Directive** (recast) replaced on 2014-02-15 the original WEEE 2002/96/EC Directive (and its later amendments 2003/108/EC and 2008/34/EC). Its last update is **Directive 2018/849/EU** of 2018-05-30. This Directive aims to recycle and minimise Waste from Electrical and Electronic Equipment (also referred to as WEEE). It encourages recycling, reuse and other forms of recovery of such technological waste and sets ambitious targets for recovery rate, variable depending on the product categories.

In the new Directive, a six-year **transitional period** was established up to 2018-08-14, during which the equipment included in its "open scope" still remained the same as per the former WEEE Directive. From 15th August 2018, the scope became "open", subject to the exclusions for various categories of "equipment", which include the **large-scale fixed installations.** *These are defined as "a large-size combination of several types of apparatus and, where applicable, other devices, which: (i) are assembled, installed and uninstalled by professionals; (ii) are intended to be used permanently as part of a building or a structure at a pre-defined and dedicated location; and (iii) can only be replaced by the same specifically designed equipment" and large-scale stationary industrial tools defined as "a large size assembly of machines, equipment, and/or components, functioning together for a specific application, permanently installed and uninstalled by professionals at a given place, and used and maintained by professionals in an industrial manufacturing facility or research and development facility".*

**Connectors and their accessories** that, as components, **are outside the scope of RoHS 2 Directive, do not fall in the scope of WEEE 2** even once "open scope"; moreover, they are primarily used in installations of industrial automation (large-scale stationary industrial tools) which are exempted from conformity to the WEEE 2 Directive.

As required by the WEEE 2 Directive, ILME will take care of any technical and administrative obligation for any ILME product that might be involved.

As a manufacturer of electrical equipment and components for industrial use, ILME acknowledges the regulations introduced by these Directives. The above-mentioned Directives are already effective national law in all EU countries. Similar regional regulations aimed at the preservation of the environment are in force across the world outside Europe.

For the products described in this Catalogue, although the restrictions of use of the above mentioned hazardous substances are not legally applicable, in that no product in this Catalogue belongs to any of the product categories described and illustrated in the above mentioned RoHS 2 and WEEE 2 Directives, the **"RoHS conformity"** is important, as it is required downstream in the supply chain. ILME has therefore carried out the necessary corrective actions, which have led to the **"RoHS conformity"** of all products in this Catalogue, wherever required.

**ILME products sold after 1st July 2006 do not contain any of the restricted substances in concentrations higher than those allowed by the RoHS 2 Directive and by the subsequent related Decisions taken by the EU Commission.**

# Fire protection standards for railway applications

The European standard EN 45545 governing fire protection on railway vehicles was published in 2013. In Italy, the various parts are:

- **UNI CEI EN 45545-1**:2013-05 Railway applications – Fire protection on railway vehicles – Part 1: General;
- **UNI CEI EN 45545-2**:2013-05 Railway applications – Fire protection on railway vehicles – Part 2: Requirements for fire behaviour of materials and components;
- **UNI CEI EN 45545-3**:2013-05 Railway applications – Fire protection on railway vehicles – Part 3: Fire resistance requirements for fire barriers;
- **UNI CEI EN 45545-4**:2013-05 Railway applications – Fire protection on railway vehicles – Part 4: Fire safety requirements for rolling stock design;
- **UNI CEI EN 45545-5**:2013-05 Railway applications – Fire protection on railway vehicles – Part 5: Fire safety requirements for electrical equipment, including that of trolley buses, track guided buses and magnetic levitation vehicles;
- **UNI CEI EN 45545-6**:2013-05 Railway applications – Fire protection on railway vehicles – Part 6: Fire control and management systems;
- **UNI CEI EN 45545-7**:2013-05 Railway applications – Fire protection on railway vehicles – Part 7: Fire safety requirements for flammable liquid and flammable gas installations.

The standard replaces the previous voluntary Technical Specification CEN/TS 45545:2009 and has formalised the withdrawal of all conflicting national standards as of 1st April 2016, the date on which the following parallel standards cease to be effective: in Italy **UNI CEI 11170-1**:2005, **UNI CEI 11170-2**:2005 and **UNI CEI 11170-3**:2005; in France, **NF F 16-101**:1988 and **NF F 16-102**:1992; in Germany, **DIN 5510-2**:2009; in United Kingdom, **BS 6853**:1999. These, however, remained applicable until 31st march 2016. All certificates covering materials issued in line with national standards remained valid in Europe up until this date. As of 1st April 2016, the only reference standard is EN 45545:2013. However, due to the huge number of customer specifications and technical documents making reference to obsolete standards, the railway business is still moving to a complete unification to the EN 45545 series.

**EN 45545-2** specifies the requirements for the fire behaviour of materials and components of railway vehicles according to the different hazard levels defined by EN 45545-1:2013 (**HL** = **H**azard **L**evel). See Table 1 – Classification of hazard levels (EN 45545-2:2013).

Each hazard level provides for its own specific test procedures, test conditions, fire protection requirements and severity (min or max threshold), ranging from **R1** to **R26**. Electrical components of small size and mass, such as electrical connectors, shall have a nominal fire behaviour rating (self-extinguishing) **94V-0 (standard UL 94)**.

The thermoplastic insulating material used in ILME connectors complies with the requirements of UL 94V-0. There are no requirements applicable to products with a combustible mass < 10 g not in contact with other unclassified products, if they are installed adjacent to components for which no certificates are available. In this case, the requirements depend on the so-called grouping rules.

Connectors are unlisted products in Table 2 of EN 45545-2:2013. As non-listed products, they must satisfy the requirements of Table 3, and as their exposed surface area is ≤ 0,2 $m^2$, the set of requirements for indoor location in a railway vehicle is **R22** while for outdoor location it is **R23** (Table 5 of EN 45545-2:2013).

For the materials of connectors, these are the sets of maximum applicable requirements. These sets establish parameters, procedures and limit thresholds (min or max) for the tests. In particular, R22 and R23 specify tests and limit values for **oxygen content** (oxygen index OI), **smoke density** (Ds max) and **toxicity** (conventional toxicity index $CIT_{NLP}$).

**The polycarbonate used by ILME in its connectors meets the limit values specified in EN 45545-2.**

See Table 2 – Requirements for unlisted products (including electrical connectors) – at following page.

Until the publication of the previously mentioned series of European standards, the most advanced fire safety standards for the railway industry were French:

- **NF F 16-101** Matériel roulant ferroviaire – Comportement au feu–Choix des matériaux;
- **NF F 16-102** Matériel roulant ferroviaire – Comportement au feu –Choix des équipements électriques;

which in turn referred to the test methods described in standards:

- **NF X 70 100** Analyse de gaz de pyrolyse et de combustion;
- **NF X 10 702** Détermination de l'opacité des fumées en atmosphèrenon renouvelée.

**Table 1 – Hazard level classification** (EN 45545-2:2013)

| **Operation Category** (#) | **Design Category** | | | |
|---|---|---|---|---|
| | A: Vehicles forming part of an automatic train having no emergency trained staff on board | D: Double decked vehicles | S: Sleeping and couchette vehicles | N: All other vehicles (standard vehicles) |
| OC 1 | HL1 | HL1 | HL2 | HL1 |
| OC 2 | HL2 | HL2 | HL2 | HL2 |
| OC 3 | HL2 | HL2 | HL3 | HL2 |
| OC 4 | HL3 | HL3 | HL3 | HL3 |
| (#) Relationship between the service, the infrastructure and the conditions for the evacuation of passengers and staff | | | | |

**Table 2 – Requirements for unlisted products (including electrical connectors)**

| Test method | Standard | Parameter | Unit | Interior | Exterior | R22 thresholds (more severe than R23) | | | ILME (polycarbonate) |
|---|---|---|---|---|---|---|---|---|---|
| Oxygen index OI | EN ISO 4589-2 | OI (min) | % | R22 | R23 | HL1: 28 | HL2: 28 | HL3: 32 | better than R22-HL3 |
| Smoke density | EN ISO 5659-2 | $D_s$ max (1) | --- | R22 | R23 | HL1: 600 | HL2: 300 | HL3: 150 | better than R22-HL3 |
| Toxicity of smoke | NF X70-100-1 NF X70-100-2 | $CIT_{NLP}$ (max)(2) | --- | R22 | R23 | HL1: 1,2 | HL2: 0,9 | HL3: 0,75 | better than R22-HL3 |
| (1) $D_s$ max = maximum specific optical density of smoke | | | | | | | | | |
| (2) $CIT_{NLP}$ (max) = maximum conventional index of toxicity of smoke | | | | | | | | | |

These latter were somewhat similar, in terms of methods, to the American standards:

- **ASTM E 662** Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials;
- **ASTM E 162** Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

Test methods referred to in the American reference standard specifying the performance criteria:

- **NFPA 130** Standard for Fixed Guideway Transit and Passenger Rail Systems.

Also widely used are the Bombardier Transportation smoke toxicity specifications:

- **SMP 800-C** Toxic Gas Generation.

In Italy, from 2006 to 31st March 2016, for installation on board railway vehicles, a certificate of conformity to the following Italian railway standards was required:

- **UNI CEI 11170-1:2005** Trains and trams – Fire safety guidelines for trains, trams and track guided vehicles – General principles;
- **UNI CEI 11170-2:2005** Trains and trams – Fire safety guidelines for trains, trams and track guided vehicles – Design recommendations – Fire containment measures – Indication, monitoring and evacuation systems;
- **UNI CEI 11170-3:2005** Trains and trams – Fire safety guidelines for trains, trams and track guided vehicles – Material fire behaviour assessment – Acceptance limits

published jointly by UNI and CEI on 2005-11-30 with parallel validity until 31st March 2016. In these standards, the requirements for materials relating to electrical connectors are contained in the 2nd schedule *"Acceptability criteria for electrical and electronic materials and components"* at the application *"All other applications including flammable materials"* (all applications other than electric cables). For these applications, four material tests are required:

- Exposure to a small flame according to EN ISO 11925-2 with, depending on the level of risk, a resistance to fire of the material of 15 s for LR1 and LR2 and a resistance of 30 s for LR3 and LR4.
- Smokiness in compliance with French standard NF F 16-101 with IF better or equal to F2 for all risk levels. The material we use is classified as F1 (better than F2) according to the tests carried out.
- Smoke optical density measurement, in compliance with French standard NF X 10-702 (from NF F 16-101) with values ≤ 100 for all risk levels LR1…4.
- Toxicity measurement, in compliance with Italian standard CEI 20-37/7, with T ≤ 2 for all risk levels LR1…4.

**Tests**

**EU** – The material tested in accordance with the European Norm **EN 45545-2**:2013 – showed an oxygen index (OI) of 38%, a Ds max (flaming) = 117 and a smoke toxicity index CITNLP = 0,16, **compliant with the requirements of EN 45545-2:2013 for all risk levels: HL1 – HL2 – HL3** and, consequently, for all the design categories (A, D, S, N) and operation categories (1, 2, 3, 4) defined in EN 45545-1:2013.

**France** - The material used in our connectors is certified by an accredited laboratory CERTIFER, according to the previously mentioned French standards **NF F 16-101** and **NF F 16-102**, and has a **classification F1** (Index Fumée I.F. = 15) and a smoke toxicity index (Index Toxicité Fumée) **I.T.C. = 18.**

Both values meet the requirements set out by the French standards and by the Italian standard UNI CEI 11170-3 schedule 2, which relates to electrical connectors.

**Germany** – The material used in our connectors also complies with the German standard **DIN 5510-2**:2009 with a **flammability class = S4, smoke spreading class = SR2** and **drip class = ST2.**

**UK** - The material was also tested according to British Standard **BS 6853**:1999, with an **R (max) index = 0,6**, consequently within the limits of Tables 7 and 8 of the standard for vehicle categories Ia, Ib and II.

**USA** - Tests compliant with American standards have also been carried out at a qualified North American laboratory, confirming compliance with the requirements set out by the US Federal Transit Administration "Recommended Fire Safety Practices for Rail Transit Material Selection" for methods ASTM E 662 (NFPA 258) (specific optical smoke density), ASTM E 162 (ASTM D 3635) (surface flammability → flame propagation index) and Bombardier Transportation SMP 800-C (smoke and gas toxicity).

# Standards and Certifications

## c UL us mark

ILME enclosures have been certified by UL as Recognised Components for the USA and Canada (cUL mark) as accessories of our set of UL and CSA certified connector inserts (file UL E115072, file CSA 082270_0_000).

The certification has been achieved by successfully completing several tests carried out in compliance with standard **ANSI/UL 50** (Enclosures for Electrical Equipment) which is equivalent to the North American voluntary standard **NEMA 250** (NEMA = National Electrical Manufactures Association) and to the equivalent Canadian standard **CSA C22.2 No.94** (Special Purpose Enclosures) for safety levels used in North America and required by the local installation codes (e.g.: NFPA 70 National Electrical Code in the US, CSA system standards for Canada); more specifically:

- **Type 12** (= NEMA 12): for internal use, similar to IP54 protection rating according to IEC/EN 60529; it covers Type 1 and Type 2.
- **Type 4** (= NEMA 4): for internal and external use, similar to IP66.
- **Type 4X** (= NEMA 4X): for internal and external use, as Type 4 + corrosion resistance, similar to IP66 protection rating.

The certification includes the enclosure series with ISO, Pg and metric cable entry as well as NPT, all special versions similar to standard types.

# Specifications

ISO 23570-3 standard and DESINA® specification compliant

### Connectors compliant with DESINA® standard

DESINA® (which stands for DEcentralised and Standardised INstAllation technology) is an innovative installation concept behind a study headed by the German manufacturers of machine tools association (VDW), with the co-operation of users (including German automotive manufacturers) and component manufacturers, which has led to the introduction of a specification aimed to standardise electrical, hydraulic and pneumatic components and their interconnection on common platform for CNC controlled machine tools and manufacturing lines.

In the last few years, the DESINA® specification has been successfully enclosed in the ISO TC 184/SC 1 “Industrial automation systems and integration / Physical device control” as an ISO standard.

This work has been completed, and the following standards have now become available:

**ISO 23570-1** Industrial automation systems and integration – Distributed installation in industrial applications: Part 1 – Sensors and actuators.

**ISO 23570-2** Industrial automation systems and integration – Distributed installation in industrial applications: Part 2 – Hybrid communication bus.

**ISO 23570-3** Industrial automation systems and integration – Distributed installation in industrial applications: Part 3 – Power distribution bus.

### EUROMAP (European Plastics and Rubber Machinery)

ILME connectors meet the Technical Recommendations:

- EUROMAP 12: CSAH / CDA / CDC inserts, 32 poles.
- EUROMAP 13: CSAH / CDA / CDC inserts, 16 poles.
- EUROMAP 14 – part 1: CSAH / CDA / CDC inserts, 16 poles (with CDC inserts the iron and constantan thermocouple crimp contacts may also be used).
- EUROMAP 14 – part 2: CSH / CNE / CCE / CSE inserts, 16 poles - CP inserts, 6 poles.
- EUROMAP 16: CD inserts, 8 poles, CSAH / CDA / CDC inserts, 10 poles.
- EUROMAP 27-1: MIXO inserts, CX 08 C and CX 04 B.
- EUROMAP 28: CSH / CSE inserts, 6 poles.
- EUROMAP 29: CSH / CSE inserts, 24 poles.
- EUROMAP 62: CSAH / CDA / CDC inserts, 32 poles.
- EUROMAP 67: CD inserts, 50 poles (CD 25 Z version).
- EUROMAP 67.1: CD inserts, 50 poles (CD 25 Z version).
- EUROMAP 70: MIXO inserts, CX 12 D.
- EUROMAP 71: CD inserts, 50 poles (CD 25 Z version).
- EUROMAP 73: MIXO inserts, CX 12 D.
- EUROMAP 74: MIXO inserts, CX 12 D.
- EUROMAP 78: MIXO inserts, CX 12 D.

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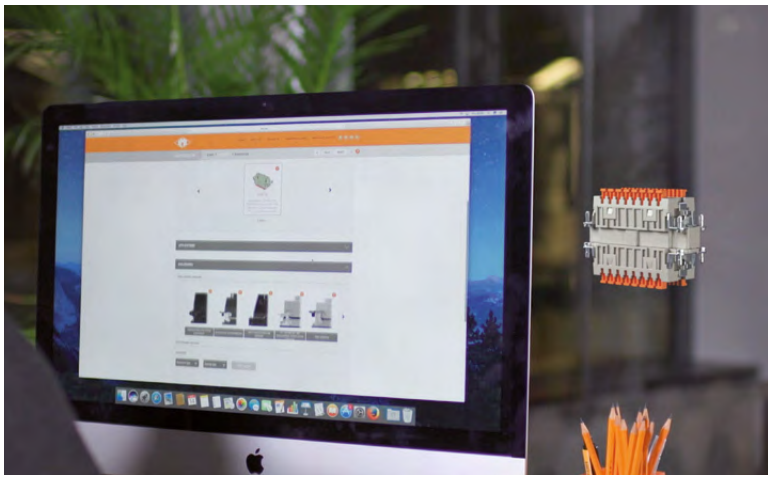

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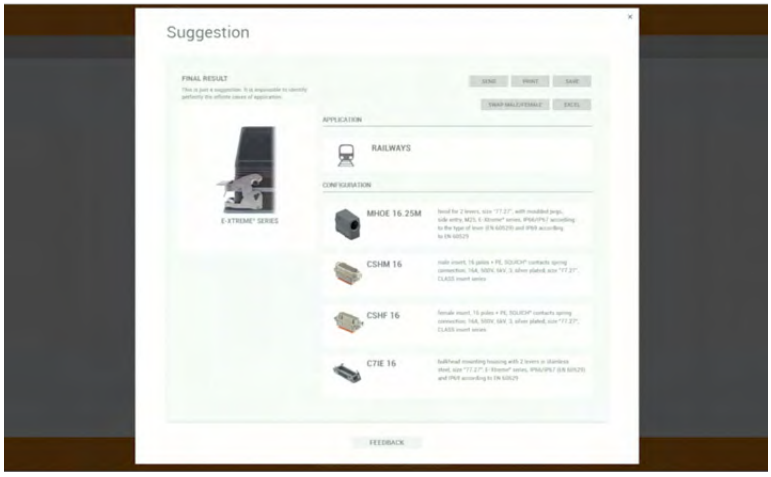


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