The Company and the Product

INDUSTRIA LOMBARDA MATERIALE ELETTRICO SpA has been operating **in Milan since 1938,** in particular in the electrotechnical sector for the manufacturing of equipment for industrial installations.
ILME reflects the traditional **entrepreneurial spirit of Lombardy,** and has enjoyed continuous expansion for over half a century. The company has carved an important role for itself in the main world markets, also operating directly in the countries that have assumed world leadership in the field of automation, including Germany and Japan.
In the **electrical connection** sector with applications in industrial automation, characterised by **top performance** and utmost **reliability needs,** ILME is today the acknowledged partner of many leading companies worldwide.
The company's fundamental values are:
product innovation, original solutions, excellent **price-quality ratio,** a customer-oriented **sense of service,** ethical behaviour and an environmentally-friendly approach.

To promote the continuing improvement of its **qualitative results,** ILME has always encouraged its collaborators to work with utmost **responsibility and participation.** The company focuses on a series of benefits to the user, including research into the most suitable materials, high quality and safe cabling, a rapid turnaround and readily available services.

CE marking

As from 1 January 1997, in order to launch electrical products on the European market the manufacturer must ensure these bear the relevant CE marking, in line with the Low Voltage Directive 73/23/EEC * (implemented in Italy as law 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).
Said marking must be placed on the product - or, if this is not possible, on the packaging, the instructions for use or the warranty certificate - and acts as a declaration by the manufacturer that the product complies with all relevant EU directives.

ILME products bear the CE marking on the product or packaging.

Almost all ILME products fall under the Low Voltage Directive. A declaration of compliance is required before applying the CE marking. This document, to which the market is not directly entitled, must be made available to the control authorities (in Italy the Ministry for Industry, Commerce and Handicraft) at all times.
In it, the manufacturer declares the technical safety standard(s) followed to manufacture 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 directive's basic safety requirements.

Compliance with harmonised technical standards (i.e. ratified by the CENELEC) constitutes presumed conformity to the directive's basic safety requirements.
The CE marking of ILME products results from said products' declaration of conformity 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 EU standards on which voluntary safety certification markings are based (e.g. IMQ and VDE).
In this way, ILME intends to award 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.

This EC declaration of conformity becomes null and void when the assembly of products includes one or more components not manufactured by us and without EC approval.

*** Note:**
new legal reference for the Low Voltage Directive is 2006/95/EC which is the consolidated edition of Directive 73/23/EEC + Directive 93/68/EEC.

On March 29, 2014, the new Low Voltage directive 2014/35/EU has been published on the Official Journal of the European Union, as a recast of the previous directive 2006/95/EC. It will enter into force on April 20, 2016.

All information contained in this catalogue
is not binding and may be changed without notice

Certification ISO 9001: 2008
Design, manufacture and distribution of industrial electrical equipment (IAF 19, 29a)
Certificate No. 50 100 11133

Inserts

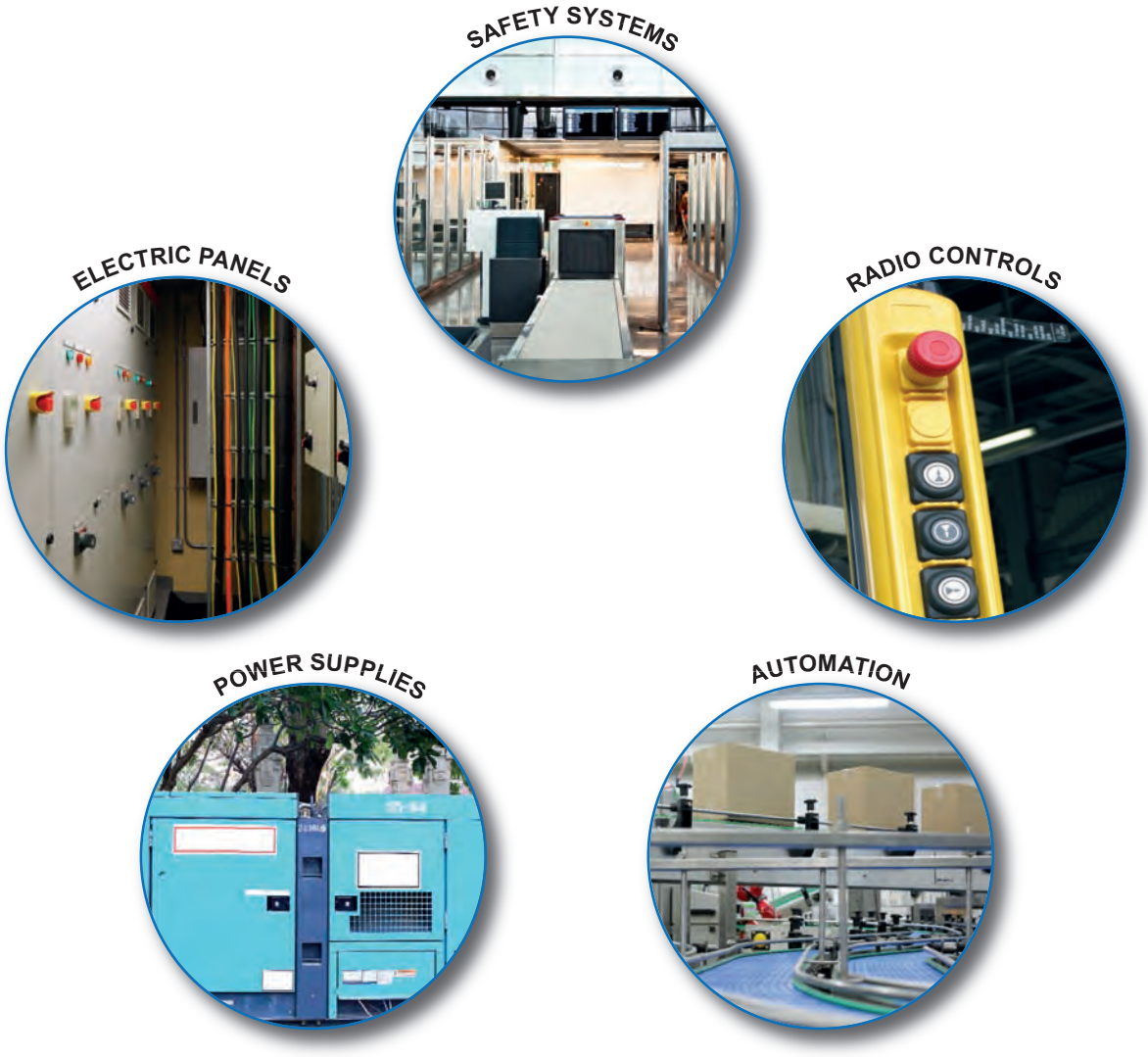
Enclosures

Complements and accessories

Choose JEI®
for standard applications

JEI® connectors are used for the electrical and electronic connection of, machines, control units, electric panels, control equipment and where a safe sectionable connection is required.

They can be used in non-aggressive industrial environments (for example, automatic assembly machines for working wood or plastic) and wherever there is a need for connections with an optimum quality/price ratio.



The JEI® series consists of inserts manufactured in UL 94 V-0 type-approved thermoplastic resin and contacts with a galvanic tin coating.

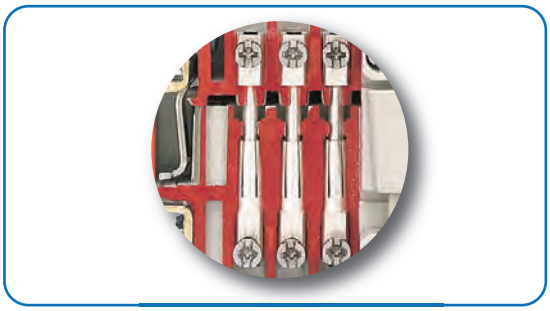
Coupling with metallic enclosures, complete with locking levers in reinforced thermoplastic or galvanised steel, makes the connection effective and robust.

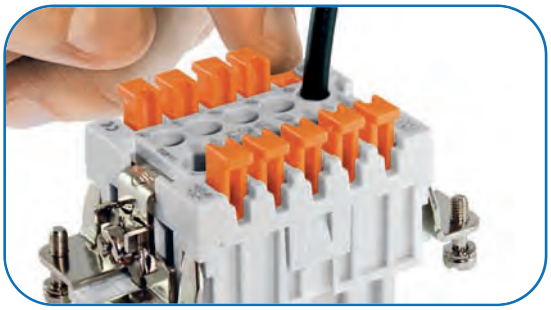
The wide range of inserts offered with their different conductor connecting techniques (screw, crimp or spring) guarantees flexibility of use and numerous choices.

JEI® inserts
for standard connections

Reliable and precision tin-plated contacts

Brass contacts with tin plating able to guarantee up to more than 200 couplings.



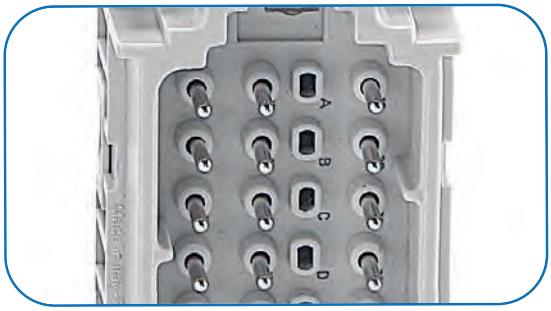


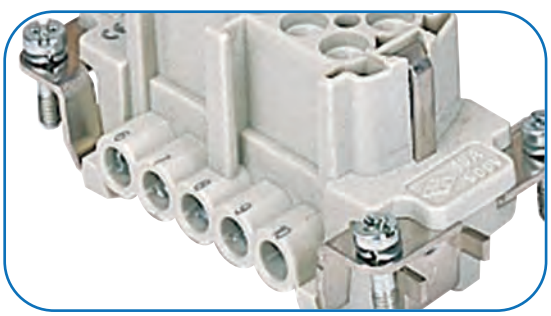
JSH inserts: “SQUICH®” quick connection

The innovative solution that fully eliminates tools in the cabling phase.
Connections are made by simply pressing.
The result? A reduction in cabling time of 50% compared to screw-type connections and 20% compared to conventional spring-type connections.

JDS inserts:
all the density you’ve been looking for in the usual space

Inserts with spring cabling able to offer up to 84 poles in the same space as a standard 48-pole connector, thanks to the compact spring connection that has allowed for the number of poles to be increased without changing overall dimensions.





JNE - JDA inserts: connection of up to 4 mm²

The inserts with screw connection can house conductors up to a maximum of 4 mm².
The mixed head screw lets you use a flat or Phillips head screw.

The JEI® enclosures make all the difference

Select the lever that best suits your needs

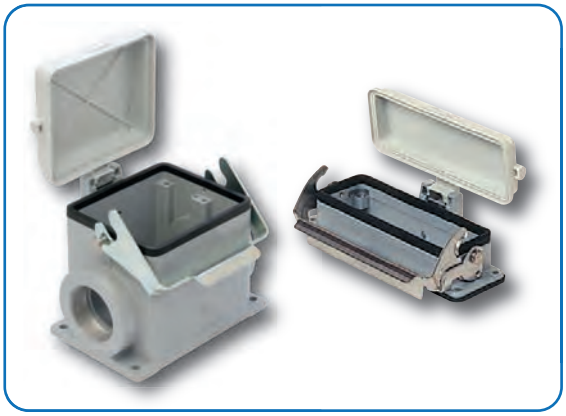
Two lever versions to create the best connection:
- JEI®-V with lever in galvanized steel, enclosure with vertical closure
- JEI®-P with lever in thermoplastic material.

JEI®-P
Thermoplastic Levers

JEI®-V
Vertical Closing

Closing covers in thermoplastic material

The enclosures with JEI®-V series levers, in galvanized steel, may be provided with hinged thermoplastic covers.
Size available: 44.27, 57.27, 77.27, 104.27, 77.62, 104.62.

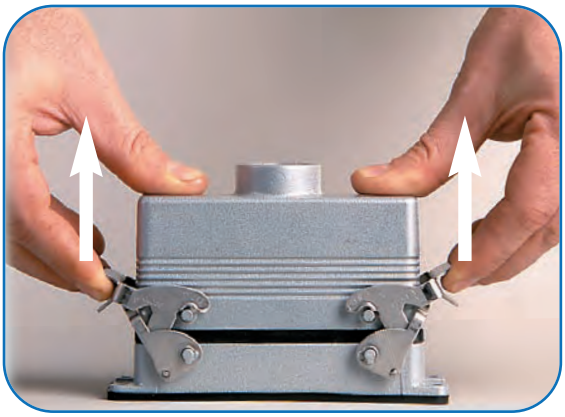


The JEI® series comes complete with:

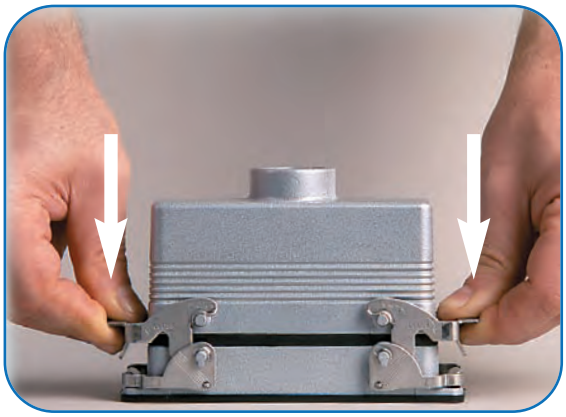
The only enclosure with vertical closure

The exclusive V-TYPE closure system, with vertical opening and closure, guarantees IP66 protection rating and, for frequent openings, it minimises mobile enclosure pin friction and wear.
The V-TYPE levers are available in sizes 44.27, 57.27, 77.27 and 104.27.

OPEN

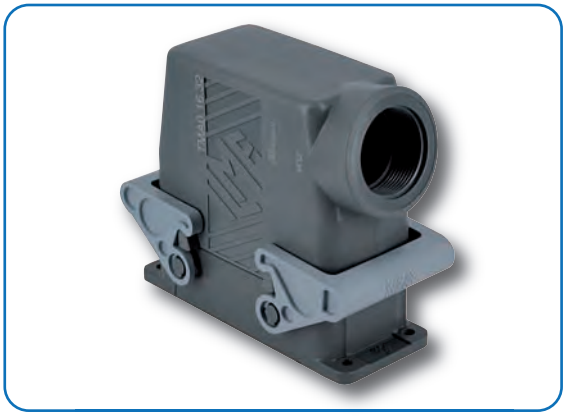


CLOSE



T-TYPE enclosures: resistant and economical

Made entirely of highly thick thermoplastic material, they guarantee considerable structural solidity and mechanical durability, combined with significant resistance to the main aggressive agents in industrial environments.
Ideal for environments where paint is discouraged.



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 single part** and tested to be compliant with the essential safety requirements of the EU Low Voltage Directive 2006/95/EC and in particular the EN 61984 standard.
The design of this “modular” system guarantees that every approved combination of inserts, enclosures and accessories cannot result as improper.

The products in this catalogue alone cannot guarantee the best functionality upon installation, as this depends also on their correct “installation 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.

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

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

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. I.L.M.E. SpA is not responsible for any different application.

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.

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

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.

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.

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.

The 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.

In order to keep the declared degree of protection (IP code), enclosures must be completed with cable glands and/or other accessories with at least an equal protection rating.

Moreover, the IP protection rating (according to EN 60529) is guaranteed when the enclosures, complete with inserts, are coupled and locked with their locking levers (or devices).

Finally, Please note:
- 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.).

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 (Series CG) cannot be guaranteed when coupled with other manufacturers’ products.

I.L.M.E. SpA takes no responsibility in verifying whether the components herein contained comply with any specific regulations of fields of application.

Inserts

The inserts of the JEI® connectors are made of UL 94 V-0 self-extinguishing thermoplastic resin and are usable in environments with temperature up to 125 °C. Different conductor connection techniques are available: screw, crimp or spring connections.
Inserts are numbered on both sides by laser printing or moulding.
You can choose the insert that best suits your needs between numerous versions of inserts on the basis of the rated voltage (from 50 to 500V), the rated current (from 10A to 16A max), the number of poles and the type of cabling:

JK 3-4 poles + ⏚ with screw terminal connection
JKS 3-4 poles + ⏚ with spring terminal connection
JDS 9, 18, 27, 42, (54), (84) poles + ⏚ with spring terminal connection
JDA 10,16 (32) poles + ⏚ with screw terminal connection
JNE 6, 10, 16, 24, (32), (48) poles + ⏚ with screw terminal connection
JSE 6, 10, 16, 24, (32), (48) poles + ⏚ with spring terminal connection
JSH 6, 10, 16, 24, (32), (48) poles + ⏚ with SQUICH® quick connection.

SQUICH® connections without tools

SPRING terminal connection **HIGH DENSITY**

TIN PLATED CONTACTS

SCREW terminal connection

SPRING terminal connection

inserts series	No. of poles [1] main contacts + ⏚	auxiliary contacts	rated current [3]	EN 61984 (2001-11) pollution degree 3 rated voltage	rated impulse withstand voltage	pollution degree	EN 61984 (2001-11) pollution degree 2 rated voltage	rated impulse withstand voltage	pollution degree	UL/CSA [2] certification rated voltage ~ or ⎓	certifications [2]
JK	**3, 4**	---	10A	230/400V	4kV	3				600V	UL
JKS	**3, 4**	---	10A	400V	4kV	3				600V	cUL
JDS	**9, 18, 27, 42, (54), (84)**	---	10A	400V	6kV	3	400/690V	6kV	2	600V	cUL
JDA	**10, 16**	---	16A	250V	4kV	3	230/400V	4kV	2	600V	(cUL)
JNE	**6, 10, (12), 16, 24, (32), (48)**	---	16A	500V	6kV	3	400/690V	6kV	2	600V	cUL
JSE	**6, 10, (12), 16, 24, (32), (48)**	---	16A	500V	6kV	3	400/690V	6kV	2	600V	cUL
JSH	**6, 10, (12), 16, 24, (32), (48)**	---	16A	500V	6kV	3	400/690V	6kV	2	600V	cUL

Crimp inserts that may be used with JEI® series tin-plated/gold-plated crimp contacts

inserts series	No. of poles [1] main contacts + ⏚	auxiliary contacts	rated current [3]	EN 61984 (2001-11) pollution degree 3 rated voltage	rated impulse withstand voltage	pollution degree	EN 61984 (2001-11) pollution degree 2 rated voltage	rated impulse withstand voltage	pollution degree	UL/CSA [2] certification rated voltage ~ or ⎓	certifications [2]
CD	**8** (without ⏚)	---	10A	50V	0,8kV	3				50V	UL, CSA, CCC, GL
CD	**7, 15, 25, 40, (50), 64, (80), (128)**	---	10A	250V [4]	4kV	3	230/400V [4]	4kV	2	600V	UL, CSA, CCC, GL
CDD	**24, 38, 42, 72, (76), 108, (144), (216)**	---	10A				250V	4kV	2	600V	UL, CSA, CCC, GL
CCE	**6, 10, (12), 16, 24, (32), (48)**	---	16A	500V	6kV	3	400/690V	6kV	2	600V	UL, CSA, CCC
CQE	**10, 18, (20), 32, 46, (64), (92)**	---	16A	500V [4]	6kV	3	830V [4]	8kV	2	600V	UL, CSA, CCC

N.B.: all inserts have a mechanical life equal to or higher than 500 coupling cycles (50 cycles for tin-plated crimp contacts)

1) Polarities shown in brackets may be achieved by using two inserts.
2) The certifications shown in brackets are pending.
3) Please check the insert load curves to establish the actual maximum operating current according to the ambient temperature.
4) Contacts partially fitted inside an insert allow inserts to be used for applications requiring rated voltages higher than those shown.
See tables on page 30 (CD inserts), page 39 (CDD inserts) and page 80 (CQE inserts).

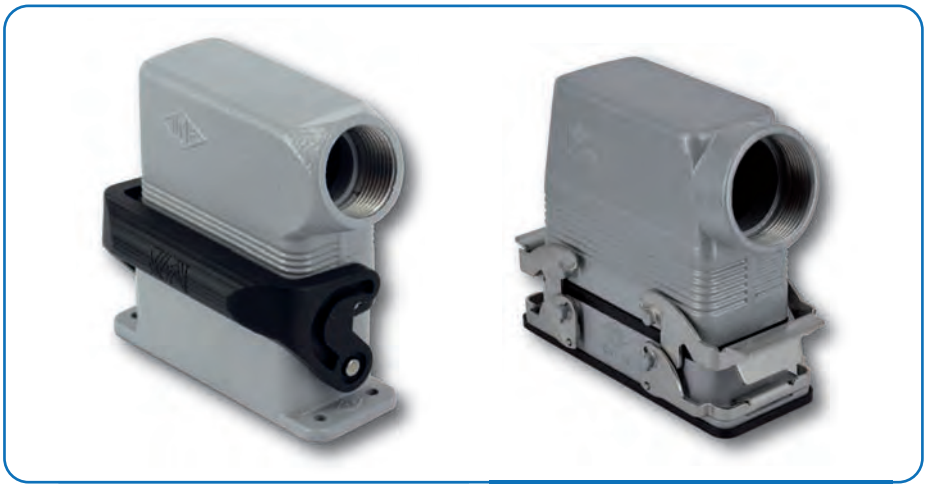
- cUL - UL for USA and Canada
- UL - with protocol E 115072
- CSA - with protocol LR 82270
- CCC - China Quality Certification
- GL - Germanischer Lloyd - 3356706 HH

inserts series	contact resistance ≤	insulation resistance ≥	ambient temperature limit (°C) min	ambient temperature limit (°C) max	degree of protection without enclosures	degree of protection with enclosures	conductor connection screw	conductor connection spring	page No.
JK	≤ 1 mΩ	≥ 10 GΩ	-40	+100	IP20	IP44, IP66/IP67	✓		27
JKS	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	IP44, IP66/IP67		✓	28 ÷ 29
JDS	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	IP65, IP66		✓	50 ÷ 59
JDA	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	IP65	✓		48 ÷ 49
JNE	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	IP65, IP66	✓		68 ÷ 73
JSE	≤ 3 mΩ	≥ 10 GΩ	-40	+125	IP20	IP65, IP66		✓	68 ÷ 73
JSH	≤ 3 mΩ	≥ 10 GΩ	-40	+125	IP20	IP65, IP66		✓	60 ÷ 67

inserts series	contact resistance ≤	insulation resistance ≥	ambient temperature limit (°C) min	ambient temperature limit (°C) max	degree of protection without enclosures	conductor connection crimp	page No.
CD	≤ 3 mΩ	≥ 10 GΩ	-40	+125	IP20	✓	32
CD	≤ 3 mΩ	≥ 10 GΩ	-40	+125	IP20	✓	31 ÷ 38
CDD	≤ 3 mΩ	≥ 10 GΩ	-40	+125	IP20	✓	40 ÷ 46
CCE	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	✓	74 ÷ 79
CQE	≤ 1 mΩ	≥ 10 GΩ	-40	+125	IP20	✓	81 ÷ 86

Multiple versions of enclosures are available, made in die cast aluminium alloy with an oven-baked coating of epoxy-polyester powder or in self-extinguishing thermoplastic material. They are resistant to impact and strong mechanical stress. The coupling stability and protection against accidental opening are assured by single or double closing devices comprising levers, springs and pegs in galvanised steel or entirely in plastic. Sealing is assured by special gaskets that protect the contact groups inside the enclosures against dust and aggressive agents. In general, the coupled enclosures with the appropriate user-selected connections guarantee IP44, IP65, IP66 and IP67 (IEC EN 60529) protection rating.

The enclosures in die cast aluminum alloy are made of in the versions:
- JEI®-P with 1 and 2 levers in thermoplastic material
- JEI®-V with 1 lever in galvanized steel
- JEI®-V with 1 lever in galvanized steel and plastic cover
- JEI®-V with 2 levers in galvanized steel



It is also possible to use the JEI® inserts in combination with the **T-TYPE** enclosures: the series of enclosures made entirely of self- extinguishing thermoplastic material.
The combination of JEI® inserts and **T-TYPE** enclosures extends the field of application of this series to environments where powder paint is discouraged.

Most of the enclosure versions have been certified by UL as Recognized Components for the USA and Canada (cUL mark) and hence are suitable accessories for 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 the protection ratings 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;
- 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.

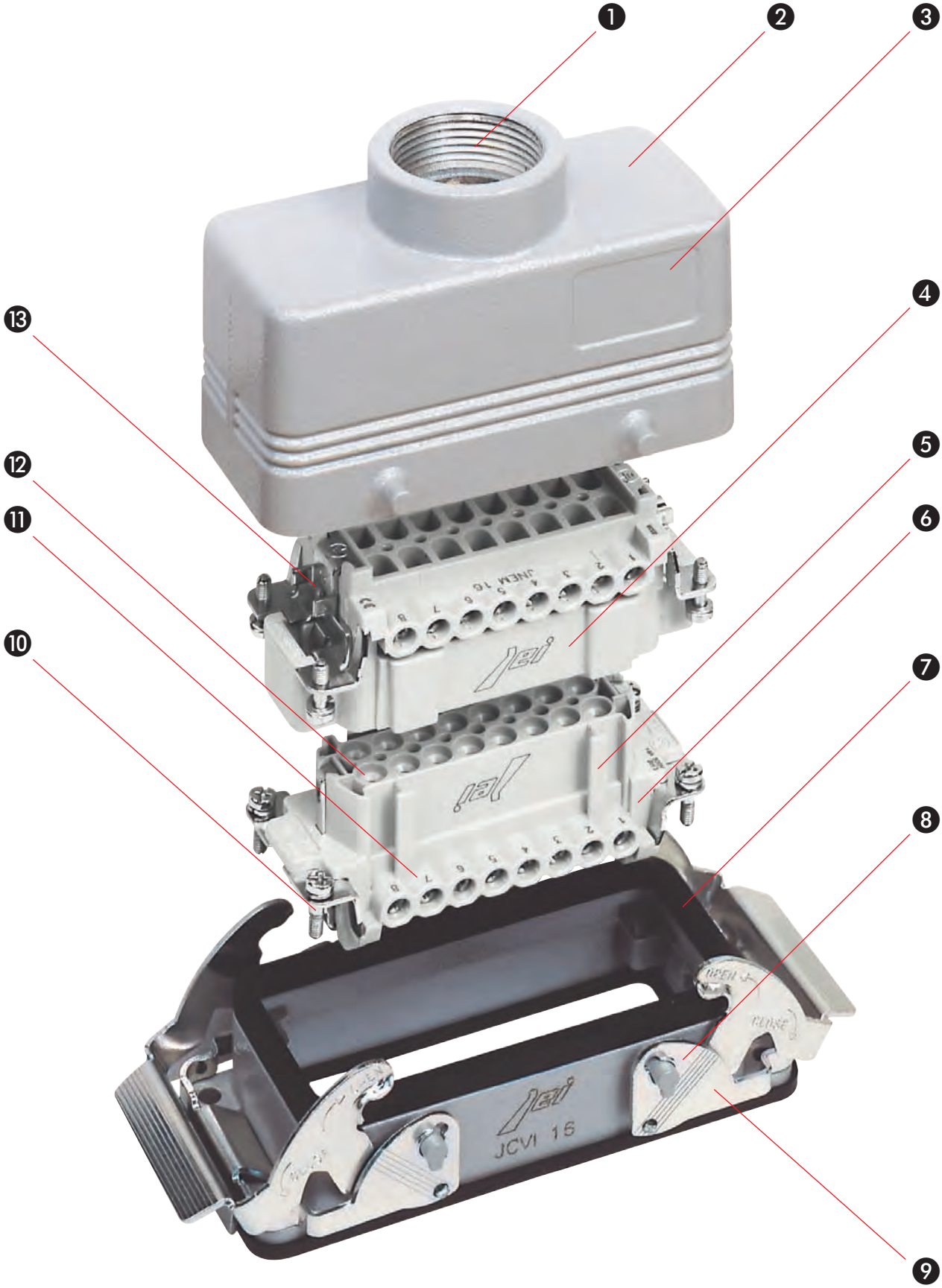
The **new RoHS directive II 2011/65/EU** of 8 June 2011, as amended, is in effect as of 3 January 2013 with the revocation of the old RoHS directive 2002/95/EC and subsequent amendment 2008/35/EC.
This directive had introduced a ban on the use of some hazardous substances in new Electrical and Electronic Equipment (EEE) introduced on the market as of 1 July 2006.
The exceptions for some applications were listed in the Directive Annex and in a certain number of subsequent EU Commission Decisions [2].
The new RoHS II directive confirms the banned and/or restricted substances: **Lead, Mercury, Cadmium, Hexavalent Chromium, Poly-Brominated By-Phenyls** and **Poly-Brominated Dy-Phenyl Ethers** (PBB and PBDE respectively, fire retardant substances for thermoplastic materials).

The single components and finished product parts are excluded from the field of application.
Multi-polar connector inserts, the relevant removable crimp contacts and the connector enclosures are excluded from the field of application of the new RoHS II Directive. Each of these "components" still meets the RoHS II directive, in their capacity as possible finished product components that already are or will be included in the field of application at the end of the transitory period (22 July 2019), when the scope of the RoHS II directive will open to include any electric and electronic equipment (EEE).
CE markings for finished products, one of the biggest new features in the new directive, is not required for components, as with the EU Declaration of Conformity.

All ILME products in this catalogue do not contain any of the limited substances in concentrations over and above those admitted by the directive and are thus compliant with the **new directive 2011/65/EU (RoHS II) issued by the European Parliament and Council on 8 June 2011 on the restricted use of some hazardous substances in electric and electronic equipment** and subsequent amendments [1] within the terms of its field of application and the transitory periods established therein for each EEE electric and electronic equipment category.
Specifically, **multi-polar connector products for industrial use, removable crimp contacts, multi-polar electric connector enclosures**, and all the relevant accessories are compliant, although not within its field of application.

PLEASE NOTE – This is not an EU Declaration of Conformity and CE markings, which could be found in accordance with other applicable EU Directives, do not refer to the RoHS II Directive.

1) At the time of publication of this Catalogue: Directives delegated of the Commission 2012/50/EU and 2012/51/EU of 10 October 2012.
2) At the date of replacement of the old RoHS Directive (3 January 2013) the following Decisions of the Commission were in force: **M1** 2005/618/EC of 18 August 2005, **M2** 2005/717/EC of 13 October 2005, **M3** 2005/747/EC of 21 October 2005, **M4** 2006/310/EC of 21 April 2006, **M5** 2006/690/EC, **M6** 2006/691/EC and **M7** 2006/692/EC of 12 October 2006, **M9** 2008/385/EC of 24 January 2008, **M10** 2009/428/EC of 4 June 2009, **M11** 2009/443/EC of 10 June 2009, **M12** 2010/122/EU of 25 February 2010, **M13** 2010/571/EU of 24 September 2010, **M14** 2011/534/EC of 8 September 2011.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❶ Threaded cable passage in various Pg diameters (types with pre-code “C”) or metric passage (types with pre-code “M”) in accordance with EN 60423, for cable entry devices in accordance with EN 50262 (NPT threading on request), may be located vertically, horizontally or frontally.

❷ Rugged die-cast aluminum alloy or self-extinguishing thermoplastic enclosures (types CK, MK, **T-TYPE**).
Surface-mounting bulkhead and hood versions are available, with or without fixed covers or with mobile protection covers.

❸ Metallic enclosures with a coated finish of epoxy-polyester with high resistance to mechanical stress and external agents. Most of the enclosures reported by using laser marking:
- the article code
- the size of the thread of cable entry.

❹ Inserts are made of UL certified self-extinguishing fibreglass reinforced thermoplastics, and feature an operating temperature range between -40 °C and +125 °C.

❺ Insert profiles polarised with asymmetrical guides to avoid incorrect matings.
Inserts have a mechanical life equal to or higher than 200 mating cycles.

❻ Inserts are manufactured in compliance with European standard EN 61984 (DIN VDE 0627).

❼ Special seal gaskets in vinyl nitrile elastomer, in anti-aging, oil-resistant, fuel-resistant, together with the cable entry devices (not supplied) provide an IP65/IP66 degree of protection for coupled connectors.

❽ Levers in galvanized steel or thermoplastic material, guarantee a perfect closure and sealing.

❾ Locking device available in two versions, simple (with one lever), or double (with two levers).
In metallic enclosures, ILME offers two different types of levers:
vertical (JEI®-V) or rotative in thermoplastic material (JEI®-P).

❿ Captive insert fastening screws, with anti-slackening spring washer or under-head knurling.

⓫ Contact position identified with numbers or codes on both sides of each insert and printed with a laser system or from a die.

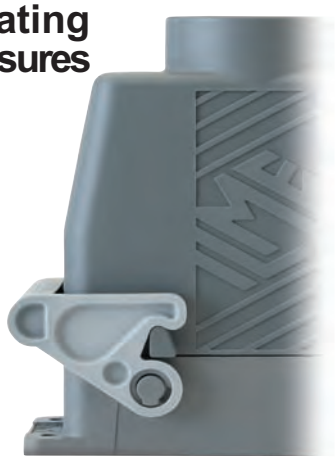
⓬ Tin plated brass contacts connected to the wires by means of captive screws supplied already slackened, or with spring terminal.

⓭ Protective earth terminal with a wide contact surface.

JEI®-P
Thermoplastic Levers

JEI®-V
Vertical Closing

T-TYPE
Insulating Enclosures



JEI®-V
Rigid Lever

Dimensioning of clearances and creepage distances

European standard EN 61984 (2009-06) was recently published for safety prescriptions for multipole connectors for industrial uses and for the relevant tests which incorporates without modification the corresponding international standard IEC 61984 Ed EN 2.0 (2008-10).
It is applicable to connectors with rated voltage values of over 50V, and up to 1000V, and rated currents values of up to 125A per pole, for which no dedicated standard exists, or to which the particular specifications or the manufacturer refer as regards the safety aspects. It can be used as a guide for connectors with rated voltage exceeding 125A per pole and those with a rated voltage less than 50V (the latter excluded from the scope of the Low Voltage Directive 2006/95/EC).
The new edition of the EN 61984 standard also introduces the definition of **connector without breaking capacity** (COC) to better distinguish this category of products from **connectors with breaking capacity** (CBC).
For terminal security and performance requirements, according to the connection technique adopted, the standard now integrally refers to the corresponding standards (IEC/EN 60999 series and IEC/EN 60352 series).
For determining the minimum through-air and surface insulation distances, i.e. creepage distances, for connectors, this standard now refers, without any modifications to standard IEC 60664-1 Ed. 2.0 (2007-04)[1].
The following illustrates the method of standard EN 61984, with reference to standard IEC 60664-1, for determining the minimum insulation in connectors. The rated characteristics for each ILME connector family are provided on pages 14 and 15. As in the first edition, the following are now obsolete: the insulation group concept and the distinction of rated voltage values into d.c. and a.c. voltage values 220V and 380V were adapted to standardised values 230V and 400V 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:
- the overvoltage categories (I, II, III, IV), according to the use of the equipment [4]: these are correlated with the transient overvoltages taken as a basis for determining the rated impulse withstand voltage;
- the degrees of pollution
- the classification of insulating materials according to their resistance to tracking
- the conditions of the electrical field (homogenous or npn-homogenous).

Overvoltage categories (or impulse withstand)
The overvoltage categories of a circuit or of an electrical system are identified by a conventional number (from I to IV) based on the limit 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 1
The rated impulse withstand voltage for equipment powered directly from the low-voltage mains (IEC 60664-1 Ed. 2.0 2008-10)

Rated supply 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 withstand voltage b) Overvoltage category			
V Three-phase a)	V Single phase	≤ V	V I	II	III	IV
		50	330	500	800	1500
		100	500	800	1500	2500
230/400 }	120-240	150	800	1500	2500	4000
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 withstand 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).

Table 1 supplies the rated impulse withstand voltage for equipment energised directly from the low voltage mains in function of the rated voltage of the power supply system, the relative voltage line-to-neutral and the overvoltage category.
Industrial machinery and installations with fixed connection to the low voltage supply system and consequently the relative components including multipole connectors, constitute an example of the equipment that belongs to the overvoltage category III.
Examples of general equipment that comes under overvoltage category II are electrical household appliances, portable tools and other household equipment or similar.
For distribution networks with rated voltage of **230/400V** (star distribution with earthed neutral), and over-voltage category III (category **III**: impulse withstanding), the demanded rated impulse withstanding voltage is **4kV**.
For distribution networks with rated voltage of **400** or **500V** (star distribution without neutral or with insulated neutral, or delta distribution, insulated or corner-earthed), and over-voltage category III (category III: impulse withstanding), the demanded rated impulse withstanding voltage is **6kV**.

Pollution degree

Pollution indicates the presence of any kind of foreign matter, whether solid, liquid or gaseous (ionised gas) that can have a negative influence on the dielectric strength or on the surface resistivity of the insulating material.
The standard establishes four degrees of pollution. The categories are identified by conventional numbers 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 except that occasionally a temporary conductivity caused by condensation may occur.
Pollution degree 3
Conductive pollution or dry, non-conductive pollution which becomes conductive due to condensation which may occur.
Pollution degree 4
The pollution generates persistent conductivity caused by conductive dust or by rain or snow.

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

Standard EN 61984 permits the sizing of surface insulation distances of connectors installed in enclosures in protection class ≥IP54 for the degree of pollution immediately below that of the application environment (e.g.: 2 instead of 3).

Extract from standard EN 61984
6.19.2.2 *For a connector in protection rating IP54 or higher , according to Publication IEC 60529, the insulating parts inside the enclosure may be sized for a lower degree of pollution.*
This applies also to coupled connectors, closure of which is ensured by the connector enclosure, and which may be uncoupled for test and maintenance purposes only.
One may therefore use connectors installed in enclosures or containers in protection rating ≥IP54, at the rated data referring to degree pollution 2 in industrial applications with degree of pollution 3, if, in compliance with the standard, the coupling of the connectors is opened only occasionally for tests or maintenance. In the event of temporary or limited duration in uncoupled state, a closing cover is, however, necessary, guaranteeing at least protection class IP54. However, this does not apply to connectors which remain uncoupled and exposed to an industrial atmosphere for an indefinite period. It should be noted, however, that pollution could penetrate inside coupled connectors, also when it comes 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, with the installer fitting such devices according to need. The degree of protection marked on the enclosures is guaranteed only for connectors coupled through the use of cable entry devices in equal or higher IP protection rating and expertly installed.

Examples of application for the selection of degree of pollution 2 for a connector
- connector on an electric motor controller, which is uncoupled only to replace a faulty motor, also in cases where degree of pollution 3 is instead specified for the system;
- connector on a module-constructed machine, 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 in protection rating ≥IP54. In this case one may even renounce equipping the connector with an IP54 enclosure.

(1) Assimilated 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 (class. CEI 109-1) (2008-04), German standard DIN EN 60664-1:2008-01 (VDE 0110-1).
(2) Harmonisation Document CENELEC HD 472 S1, Italian standard CEI 8-6 (1989) + CEI 8-6;V1 (1997), German standard DIN IEC 60038:2002-11.
(3) Italian standard CEI 64-8, German standard DIN VDE 0100.
(4) EN 60664-1 modifies the definition to "impulse withstanding category".

Insulating material group

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) is assumed as index of the resistance to creep currents of the insulating materials in the presence of atmospheric contaminating agents (standard IEC/EN 60112).
The CTI constitutes the numeric value of the maximum voltage at which a material can resist against 50 drops of an electrolytic test solution without tracking, i.e. without a progressive formation of conductive paths on the surface of the solid insulating material (and permanent electric arc between the electrodes of the test equipment) due to the combined effect of electrical 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

The values for groups IIIa/IIIb (Tab. F.2, IEC 60664-1) are identical for the purpose of determining the creepage distance values.
The insulating materials used to manufacture the ILME multipole connectors belong to groups IIIa / IIIb.

Electric field conditions

The insulation clearance is determined in Table 2 of IEC 60664-1, bearing in mind the following influencing factors:
- rated impulse withstand voltage
- electric field conditions
- 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;
- the micro-environment.

The shape and arrangement of the conductive parts influence the homogeneity of the electric field and consequently the clearance needed to withstand a given voltage.
The clearances in Case A (non-homogeneous field) have the required impulse withstand 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 withstand test.

Determination of clearances

In accordance with standard IEC 60664-1, the following must be identified to determine it:

a) The rated voltage of the power supply (usually 230/400V and therefore a conventional voltage line-to-neutral of **300V,** in star distribution networks with earthed neutral, or 400V for star networks without neutral, or with insulated neutral, or in networks with the distribution transformer's secondary winding delta connected, insulated or corner-earthed and, therefore, with conventional phase voltage of 600V);
b) The overvoltage category (usually **III**);
c) The rated impulse withstand voltage determined from Table 1 of IEC 60664-1 (usually **4 kV** or **6 kV**)
d) The type of electric field to which the parts through which the current flows shall be subjected (worse case = **inhomogenous field**) and the degree of pollution (usually **3**).

The standard **EN 61984** requires that the **creepage distance** be dimensioned according to IEC 60664-1. For distances up to 2 mm of insulation, typically to connectors for printed circuits, the reference can be, alternatively, standard IEC 60664-5, to be read in conjunction with IEC 60664-1. The minimum through-air insulation distance is therefore given by Table F.2 of IEC 60664-1, according to the rated impulse derived from **Table B.1** of the same standard which is part of Attachment B (informative) Rated voltages of power supply networks for different modes of overvoltage control.
This table is attributable in particular to devices that do not provide any upstream voltage discharge and represents, therefore the "worst case" and replaces **Table 5** of the previous edition of EN 61984.
The rated impulse withstand voltage must be chosen based on the nominal supply voltage and overvoltage category.
The assignment of connectors to a particular overvoltage category (usually **III**) is effected according to the rules of IEC 60664-1.

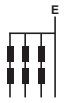
Rated voltage

Voltage value assigned by the manufacturer to the connector refer to the operating and performance characteristics

NOTE – A connector may have more than one rated voltage value.
[IEC 60664-1:2007, definition 3.9, modified]

As concerns the choice of the type of electric field, the through-air insulation distances via windows and openings in the enclosures of insulating material, must comply with the values of case A in Table of IEC 60664-1. i.e. for non uniform field conditions.

TABLE B.1
Intrinsic control or control of equivalent protection (IEC 60664-1 Ed.2.0 (2007-04)

Phase-neutral voltages obtained from AC or DC rated voltages up to and including (1)	Rated voltages currently used throughout the world				Rated impulse withstand voltage for the device (1)			
	Three phase four wire systems neutral earthed 	Three-phase three-wire systems not earthed 	Singl-phase two-wire AC or DC systems	Singl-phase three-wire AC or DC systems				
					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, 347, 380, 400, 415, 440, 480	220	220-440	1500	2500	4000	6000
600	347/600 380/660 400/690 417/720 480/830	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 2 IEC 60664-1 through-air insulation distance

TABLE F.2*)
Minimum clearance for insulation co-ordination
(IEC 60664-1 Ed.2.0 (2007-04))

Requested impulse withstand voltage (1) (5)	Minimum clearances up to 2.000 m. above sea level					
	Case A Non-homogeneous 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)
0,40	0,02			0,02		
0,50 (2)	0,04			0,04		
0,60	0,06			0,06		
0,80 (2)	0,10			0,10		
1,0	0,15			0,15		
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	0,60	0,60	
3,0	2,0	2,0	2,0	0,80	0,80	
4,0 (2)	3,0	3,0	**3,0**	1,2	1,2	1,2
5,0	4,0	4,0	4,0	1,5	1,5	1,5
6,0 (2)	5,5	5,5	**5,5**	2,0	2,0	2,0
8,0 (2)	8,0	8,0	**8,0**	3,0	3,0	3,0
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	8,0	8,0	8,0
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, at the maximum impulse voltage that can occur at the clearance distance (see 5.1.5),
— for primary insulation directly exposed or significantly affected by transient overvoltages from the low voltage power supply (see 4.3.3.3, 4.3.3.4.1 and 5.1.6), the rated equipment impulse voltage,
— for the primary insulations (see 4.3.3.4.2), the maximum impulse voltage that can occur in the circuit.
For reinforced insulation, see 5.1.6.
(2) Preferential values specified in 4.2.3 [? table 1].
(3) For printed circuit material, the values of degree of pollution 1 apply except that the value shall not be less than 0.04 mm as specified in Table F.4
(4) These minimum clearances given for pollution degrees 2, 3 are based on the reduced resistance characteristics of the corresponding surface insulation distance in wet conditions(see IEC 60664-5).
(5) For parts or circuits inside equipment subjected to impulse voltages compliant with 4.3.3.4.2, interpolation of values is allowed. However, normalization is achieved using the series of preferred impulse voltage values of 4.2.3.
(6) The dimensions for degree of pollution 4 are those specified for degree of pollution 3, with the exception that the minimum through-air insulation distance is 1.6 mm.

When the clearance is less than the value indicated for Case A an impulse withstand voltage test certificate is required.
Compared to the previous edition of IEC 60664-1 Table F.2 is has been changed (already with the Variant 2). In particular, the columns referring to degree of pollution 4 have been eliminated. The definition of this degree is varied in 6.2 to: “permanent conductivity occurs, due to conductive dust, rain or other humid conditions”. The through-air insulation distances for degree of pollution 4 area as specified for degree of pollution 3, with the exception that the minimum through-air distance is 1.6 mm.
In 6.3 it states that “the size of the surface distances can not be specified in presence of permanent conductive pollution (pollution degree 4).
For temporarily conductive pollution (pollution degree 3) the insulation surface can be designed to avoid the formation of a continuous conductive pollution path, for example using ribs or grooves”.

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

If the component respects the minimum through-air insulation distance prescribed for live parts of opposing polarities, it is exempted from the impulsed voltage withstanding 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 2000 m asl).
However, if this distance is not respected, passing the test gives one the right to declare the relevant rated impulse withstanding voltage.
Declaration of the rated impulse withstanding voltage is optional for standard EN 61984: if the manufacturer declares the rated impulse withstanding voltage, the impulse withstanding voltage test is, in any event, necessary as dielectric verification.
Alternatively, if the manufacturer does not declare this rated value, the voltage withstanding dielectric 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 impulsive test voltages of wave shape standardised at 1.2/50 µs.
To this end, standard EN 61984 provides the following cross-reference table:

TABLE 8
Test voltages (EN 61984 Ed. 2.0 - 2009-06)

Rated impulse withstand voltage U_{ipm} kV	Test voltages Impulse withstand * voltage (a) kV (1.2/50 µs) at 2000 above sea level	at sea level	Withstand voltage (r.m.s. value) kV (50/60 Hz)
0,5	0,5	0,55	0,37
0,8	0,8	0,91	0,50
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

* (a) If the test laboratory is situated between sea level and an altitude of 2000 m asl, interpolation of test impulsed voltage is allowed.

NOTE:
This table uses the characteristics of the non-homogeneous field, Case A of IEC 60664-1

Rated impulse withstand voltage
The rated impulse withstanding voltage assigned by the manufacturer to the connector, which refers to the withstanding capacity of its insulation with respect to transient overvoltages [IEC 60664-1:2007, definition 3.9.2, modified].
Impulse withstand voltage
Maximum peak value of a voltage impulse of prescribed shape and polarity which does not cause insulation reduction under specified conditions.
NOTE - The impulse withstand voltage is greater than or equal to the rated impulse withstand voltage [IEC 60664-1:2007, definition 3.8.1, modified].

Determination of creepage distances

For the **minimum surface insulation distance** (creepage distance), i.e. *"the shortest distance along the surface of the insulation material between two conducting parts"* (IEC 60664-1 definition 3.3) standard IEC 61984:2009 for connectors refers to that prescribed by standard **IEC 60664-1:2007** in **Table F.4**. It is determined according to rated voltage, degree of pollution and insulating material group. The rated voltage providing access to Table 6 (rationalised voltage of the power supply system) is determined by Table 3a of IEC 60664-1 for single phase two or three wire a.c. or d.c. systems or Table 3b for three-phase three or four wire a.c. systems. Usually for three-phase systems with 230V/400V rated voltage, the conventional line-to-line insulation voltage is 400V and the line-to-earth for TT or TN systems is 250V. For three-phase systems with 400V or 500V rated voltage the conventional line-to-line insulation voltage is respectively 400V and 500V.
The degree of pollution must be specified according to standard 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 degree of pollution.

TABLE F.3a
Single phase two or three wire a.c. or d.c. 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	-

TABLE F.3b
Three phase 4 or 3 wire a.c. 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

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

With this voltage value, the pollution degree and the materials group the minimum creepage distance can be determined using **Table 6**.

TABLE F.4

Creepage distances to avoid failure due to surface currents
[IEC 60664-1 Ed.2.0 (2007-04)]

Effective voltage [1]	Minimum creepage distances								
	Materials for printed circuits								
	Pollution degree								
	1	2	1	2			3		
	All material groups mm	All material groups except IIIb mm	All material groups mm	All material groups I mm	All material groups II mm	All material groups III mm	All material groups I mm	All material groups II mm	All material groups III [2] mm
10	0,025	0,040	0,080	0,400	0,400	0,400	1,000	1,000	1,000
12,5	0,025	0,040	0,090	0,420	0,420	0,420	1,050	1,050	1,050
16	0,025	0,040	0,100	0,450	0,450	0,450	1,100	1,100	1,100
20	0,025	0,040	0,110	0,480	0,480	0,480	1,200	1,200	1,200
25	0,025	0,040	0,125	0,500	0,500	0,500	1,250	1,250	1,250
32	0,025	0,040	0,14	0,53	0,53	0,53	1,30	1,30	1,30
40	0,025	0,040	0,16	0,56	0,80	1,10	1,40	1,60	1,80
50	0,025	0,040	0,18	0,60	0,85	1,20	1,50	1,70	1,90
63	0,040	0,063	0,20	0,63	0,90	1,25	1,60	1,80	2,00
80	0,063	0,100	0,22	0,67	0,95	1,30	1,70	1,90	2,10
100	0,100	0,160	0,25	0,71	1,00	1,40	1,80	2,00	2,20
125	0,160	0,250	0,28	0,75	1,05	1,50	1,90	2,10	2,40
160	0,250	0,400	0,32	0,80	1,10	1,60	2,00	2,20	2,50
200	0,400	0,630	0,42	1,00	1,40	2,00	2,50	2,80	3,20
250	0,560	1,000	0,56	1,25	1,80	2,50	3,20	3,60	4,00
320	0,75	1,60	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]	71,0 (56,8) [4]	80,0 (64,0) [4]
6 300			25,0	32,0	45,0	63,0	80,0 (64,0) [4]	90,0 (72,0) [4]	100,0 (80,0) [4]
8 000			32,0	40,0	56,0	80,0	100,0 (80,0) [4]	110,0 (88,0 [4]	125,0 (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]	100,0 [3]	140,0 [3]	200,0 [3]			
25 000			100,0 [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 insulation according to the working voltage.
— for main and supplementary insulation of the circuit powered directly by the network (see 4.3.2.2.1), at the rationalized voltage of Table F.3a or Table F.3b, on the basis of the rated voltage of the equipment or rated insulation voltage.
— for main and supplementary insulation of the system, device and internal circuits not powered directly by the network (see 4.3.2.2.2), the highest rms voltage which can occur in the system, in the device or in the internal circuit, powered at rated voltage and in the combination of the most onerous operating conditions foreseen by the rated characteristics of the device.
(2) Materials group IIIb is not recommended for application with pollution degree 3 above 630V.
(3) Provisional data based on extrapolations. Technical committees that have other information based on experience can use their dimensions.
(4) The values shown in brackets may be applied to decrease the creepage distance in the presence of ribbing (see 5.2.5).

NOTE: The high precision used in indicating creepage distances in this table does not mean that the uncertainty of measurement should be of the same order of magnitude.

NOTE – in **boldface** the typical values for multipole rectangular connectors for industrial uses are shown.

Recommended tightening torque and size of screwdriver

size of screw	connector type	tightening torque (Nm)	tightening torque (lb.in)	recommended size of screwdriver (mm)
M3	JK, JKS, CD 07, CD 08	0,5	4,4	0,5x3
M3	JNE, JDA	0,5	4,4	Ph0 or 0,8x4
M3	screw for fastening to enclosures, all series except T-TYPE	0,5 — 0,8	4,4	Ph1 or 0,8x4
M3	screw for fastening to T-TYPE enclosures	0,5	4,4	Ph1 or 0,8x4
M4	screw of earthing terminal	1,2	10,6	Ph2 or 1,0x5,5

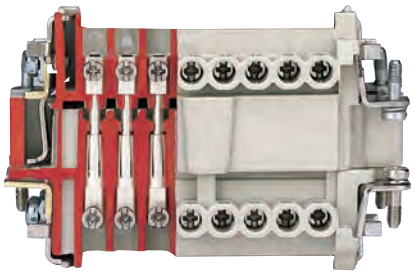
Increasing the tightening torque does not improve considerably the contacts resistances. The screw torques are selected according to standard EN 60999-1, to provide excellent mechanical, thermal and electric behaviour. The conductor or terminal may be damaged if the recommended values are significantly exceeded.

Stripping length

connector inserts connection technique	conductor section (mm^2)	 (AWG)	stripping length ** (mm)
Screw			
JK	0,75-2,5	18-14	6
JNE, JDA	0,5-4	20-12	7 **
Crimp			
CD, CDD	0,14-2,5 *	26-14	8 (* 6 for 2,5 mm^2)
CCE, CQE	0,5-4	20-12	7,5
Spring			
JSE, JSH,	0,14-2,5	26-14	9-11
JDS	0,14-2,5	26-14	9-11
JKS	0,14-2,5	26-14	9-11

** The stripping length for prepared wires with bush crimped depends on that of the bush itself.

contacts with screw terminal connections with or without wire protection



description

The different types of conductor connections to the male and female inserts are described on the right.
The types are summarised as follows:

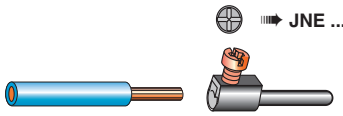
- screw terminals
- spring connection terminals

N.B.:
for all inserts with screw terminals it is important that the right torsional torque is applied to the screws in order to prevent wrong contacts or damage to the conductor, the screw or the terminal (see data mentioned in the inserts pages).

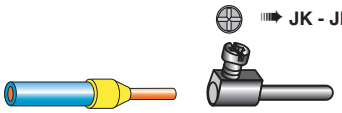
description

inserts: JK - JNE - JDA

The connections of the conductors to the female and male inserts is made via screws (in accordance with standard EN 60999-1).
Two different types of clamping are possible:
- with pressure plate for unprepared conductors
- without wire protection that requires the conductors to be prepared with bush terminals



with wire protection



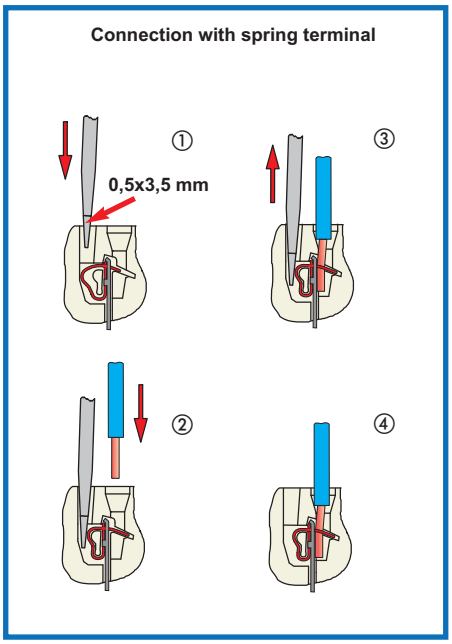
without wire protection

contacts connected with spring terminal

description

inserts: JDS

In this layout the wires are connected to the socket and plug insert contacts by means of a spring terminal.
This type of connection offers the following advantages:
- no special wire preparation
- a screwdriver with a 0,5 x 3,5 mm blade is the only tool required to insert the wire in the contact
- offers an excellent fastening solution and a great resistance to strong vibrations
- allows rigid and flexible wires with sections between 0,14 and 2,5 mm² to be used (both with non-prepared conductors and those prepared with ferrule)
- allows conductibility tests under load to be carried out through the screwdriver insertion section, without splitting the insert
- greatly reduces insert preparation and cabling times.

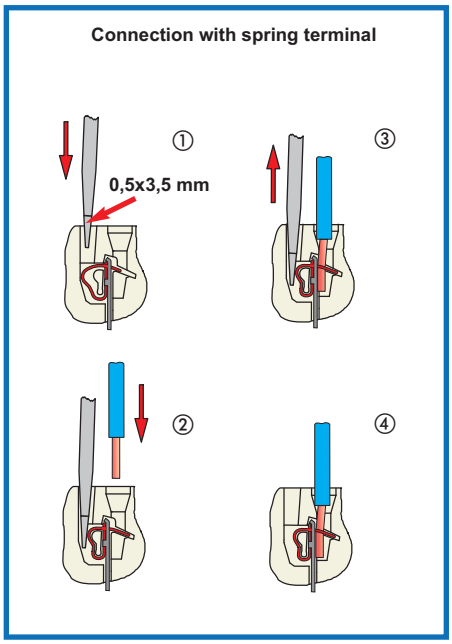


contacts connected with spring terminal

description

inserts: JSE

In this layout the wires are connected to the socket and plug insert contacts by means of a spring terminal.
This type of connection offers the following advantages:
- no special wire preparation
- a screwdriver with a 0,5 x 3,5 mm blade is the only tool required to insert the wire in the contact
- offers an excellent fastening solution and a great resistance to strong vibrations
- allows rigid and flexible wires with sections between 0,14 and 2,5 mm²to be used (both with non-prepared conductors and those prepared with ferrule)
- allows conductibility tests under load to be carried out through the screwdriver insertion section, without splitting the insert
- greatly reduces insert preparation and cabling times.

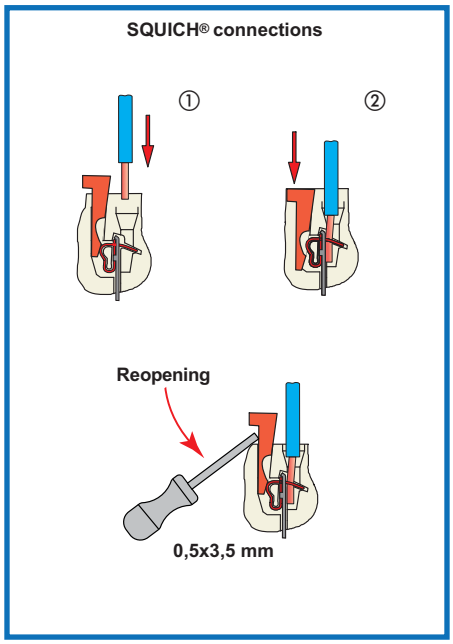


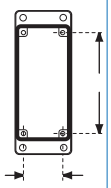
spring connected contacts with actuator button

description

inserts: JSH

In this layout the wires are connected to the socket and plug insert contacts by means of a spring terminal with actuator button.
This type of connection offers the following advantages:
- no special wire preparation **(other than stripping)**
- no cabling tool is necessary
- offers an excellent fastening solution and a great resistance to strong vibrations
- allows rigid and flexible wires with sections between 0,14 and 2,5 mm² (26 - 14 AWG) to be used (both with non-prepared conductors and those prepared with ferrule)
- greatly reduces insert preparation and cabling times
- a screwdriver with a 0,5 x 3,5 mm blade is the only tool required to remove the wire from the contact.









	rated current						
	10A	10A	10A	10A	16A	16A	16A
enclosure versions						**insert series**	
enclosures size	JEI-P pages	JEI-V pages	T-TYPE pages	COB pages	CK - CKA pages	JK, JKS	CD	CDD	JDS	JDA	CQE	JSH, JNE JSE, CCE
						insert polarity + ⏚						
21.21	✗	✗	✗	✗	✔ 123 - 127	3 4	7 8#					
49.16	✔ 88 - 89	✗	✗	✔ 145	✗		15			10		
66.16	✔ 90 - 91	✗	✗	✔ 145	✗		25	38		16		
44.27	✔ 92 - 93	✔ 102 - 104	✔ 134 - 135	✔ 143 - 144	✗			24	9		10	6
57.27	✔ 94 - 95	✔ 105 - 109	✔ 136 - 137	✔ 143 - 144	✗			42	18		18	10
77.27	✔ 96 - 97	✔ 110 - 114	✔ 138 - 139	✔ 143 - 144	✗		40	72	27		32	16
104.27	✔ 98 - 99	✔ 115 - 119	✔ 140 - 141	✔ 143 - 144	✗		64	108	42		46	24
77.62	✔ 100 - 101	✔ 120 - 121	✗	✗	✗		80	144	54		64	32
104.62	✗	✔ 122	✗	✗	✗		128	216	84		92	48

✔ = normal production
✗ = currently unavailable

\# = polarity without earth contact

The polarity values in "**red**" are obtained using double inserts.

Changeover from Pg threads to M metric threads

After 31st December 1999, the German safety standard DIN VDE 0619 (1987-09) and the standards it refers to - DIN 46319 for dimensions with metric threads and DIN 46320 (T1-T4), DIN 46255 and DIN 46259 for dimensions with Pg threads (Pg= Panzerrohr-Gewinde: literally “threads for armoured pipes”) - were withdrawn and European standard EN 50262 “Metric cable grippers for electrical installations” has been in force since 1st January 2000.
This standard defines the new sizes with metric threads for cable grippers according to EN 60423 and establishes the safety prescriptions.
Conversely, it does not specify the dimensions, such as the size of the tightening wrench, the diagonal dimension, or the dimensions of the tightness seals, as was the case in the withdrawn DIN for Pg cable grippers.
The standard came definitively into force on 1st April 2001, when the contrasting national standards were withdrawn.
It is valid in all member countries of CENELEC (European Electrical Standardisation Committee) and its publication has led to a broadening of the supply of enclosures for multi-pole connectors for industrial use, to include new enclosure versions with cable entry suitable for metric cable grippers.
Cable gripper producers have introduced the new metric series to add to the Pg size series, to gradually replace the latter type.
The transition period indicated in the new standard should have ended on 1st March 2001, after which date the use of entry devices for Pg cables and, as a result, enclosures with Pg thread, should have ended in new installations.
Nevertheless, both the cable entry devices and the relevant enclosures with Pg thread, may continue to be used as spare parts.
For the CE marking of these items, observance of the safety conditions specified by the Low Voltage Directive is sufficient.
To distinguish hoods and surface-mounting housings with metric entries from the relevant Pg versions (marked with a C pre-code), the ILME metric types are marked with an M pre-code.
The transposition table below indicates the correspondence rule adopted in most cases by ILME for creating the new metric versions.

Pg ➔ metric transposition

Pg	metric
Pg 11	M 20
Pg 13.5	M 20
Pg 16	M 20
Pg 21	M 25
Pg 29	M 32
Pg 36	M 40
Pg 42	M 50

Cable diameter for use with ILME cable glands (for more information ask for the technical catalogue

Ø in mm				metric thread	
serie	**20**	**25**	**32**	**40**	**50**
AS M..P	from 6 to 12,5	from 10 to 18	from 14 to 24	from 15 to 24	from 23 to 30
AS M..E	from 8 to 12,5	from 13,5 to 18	from 17 to 24		
AG M..T	6-8-10	11-14-17	19-21-24	26-29-32	35-38-41
AG M..I	from 5 to 12,5	from 9 to 18	from 14 to 25	from 18 to 32	from 24 to 38,5
AG M..R	6-8-10	11-14-17	19-21-24		

IP degree of protection and the EN 60529 standard

The minimum IP degree of protection is regulated by the CEI 64-8 installation standards (inclusion of the harmonisation documents of the CENELEC HD 384 series and the IEC 60364 publication) which, in part 7, cover a number of special environments: construction and demolition sites, structures designed for agricultural or livestock breeding use, restricted conductor areas, caravans and caravan sites, environments with a greater risk in case of fire, public performance and entertainment areas, pools and, in the future, fountains and marinas and harbour areas. The standard is applicable to enclosures for electric materials with a rated power no greater than 72.5 kW.
All the equipment must be installed according to the rule of art and must comply with any manufacturer’s assembly instructions. When components of different degrees of protection are assembled, the resulting board or distribution system will assume the lowest degree of protection of the mounted components.

The range of ILME enclosures presented in this catalogue offers the following range of protection:

IP44: protection against the *penetration of solid foreign objects* with a diameter equal to or greater than 1 mm and for protection against the intrusion of dangerous parts with an access calibre of Ø 1 mm (1st digit), and protected against the *dangerous effects of water spray* from all directions (2nd digit).
IP55: protection against the *penetration of solid foreign objects* with a diameter equal to or greater than 1 mm and for protection against the *intrusion of dangerous parts* with an access calibre of Ø 1 mm (1st digit), and protected against the *dangerous effects of water spray* from all directions (2nd digit).
IP66: total protection against *dust* and access to *dangerous parts* with an accessibility calibre of Ø 1 mm (1st digit), and protected against *powerful water jets* such as sea waves (2nd digit).
IP67: total protection against *dust*, and from *access to harmful parts* with accessibility of Ø 1mm (1st digit), and protection against *the effects of prolonged submersion* (30’) in water at the maximum depth of 1 m (2nd digit) [1].
IP69: total protection against dust, and from access to harmful parts with accessibility of Ø 1mm (1st digit), and protection against water jets high pressure and high temperature (2nd digit).
These enclosure have also successfully passed the tests required for the IPX6 protection rating compliant with EN 60529 standard and for the IPX9K protection rating compliant with DIN 40050-9 standard.

[1] The **IP66/IP67** degree of protection will officially be introduced in the next amendment 1 of the standards IEC EN 60309-1 and IEC EN 60309-2 (and of the relating IEC standards). It is already accounted for in the IP degree of protection standard EN 60529 as a ”versatile” form of protection, covering the fact that the temporary immersion resistance test (protection IPX7) does not automatically comply with the two lower degrees of protection IPX6 and IPX5, tested with the respective jet tests. If the end user requires the equipment to resist both against temporary immersions and pressurized water jets, declaredly IP66/IP67 devices with double marking must be selected.

The following table shows the different levels of protection required by the IP standard.

First Digit
Protection of people against contact with harmful parts

IP	Solid external objects	Protection
0		none
1		against solid objects with Ø over 50 mm (e.g. contact with hand)
2		against solid objects with Ø over 12 mm (e.g. contact with finger)
3		against solid objects with Ø over 2,5 mm (e.g. tools and wires)
4		against solid objects with Ø over 1 mm (e.g. fine tools and wires)
5		against dust (no harmful deposit)
6		total against dust

Second Digit
Protection of materials against harmful penetration of water

IP	Tests	Protection
0		none
1		against vertical drops of water
2		against drops of water with an inclination of 15° from the vertical
3		against drops of water with an inclination of 60° from the vertical
4		against splashing water from all directions
5		against water jets from all directions
6		against powerful water jets similar to sea waves
7		against the effects of temporary immersion o a maximum depth of 1 meter
8		against the effects of prolonged submersion in water (duration and / or depth according to agreements
9		against water jets high pressure and high temperature

JEI®-P version

description

JP series

- made of die cast aluminium alloy
- with epoxy-polyester powder coating
- gaskets in anti-aging, oil-resistant, grease-resistant and fuel-resistant vinyl nitrile elastomer
- locking device with levers in self- extinguishing thermoplastic material
- degree of protection for coupled connectors is **IP65** (according to norm **IEC/EN 60529)**.

JEI®-V version

description

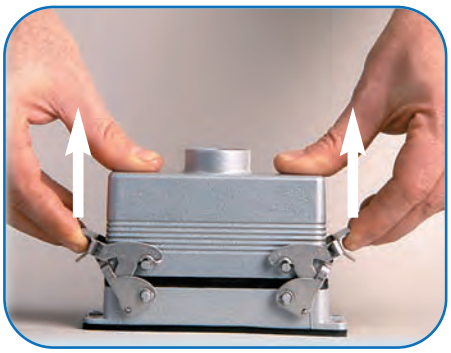
JCV and JMV series

- made of die cast aluminium alloy
- with epoxy-polyester powder coating
- gaskets in anti-aging, oil-resistant, grease-resistant and fuel-resistant vinyl nitrile elastomer
- locking device with levers in galvanized steel.

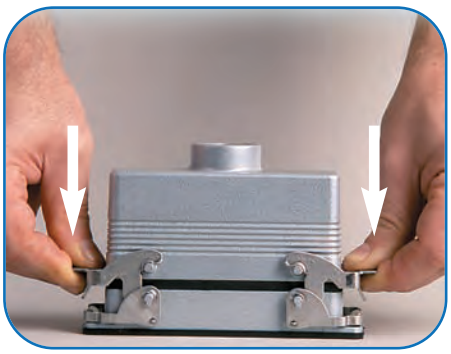
The tight seal after closure and the simplicity of the movement.

- **The lever occupies a very small space** during the closing phase.
- **It is recommended** in cases in which the **weight of the cable** tends to open elastic levers, like those with vertically installed connectors and cable exits in the bottom.

OPEN



CLOSE



JEI®-V version

description

JCH series JMH series

- made of die cast aluminium alloy
- with epoxy-polyester powder coating
- gaskets in anti-aging, oil-resistant, grease-resistant and fuel-resistant vinyl nitrile elastomer
- locking device with levers in galvanized steel.

CK / CKA standard version

description

CK and MK series

- in self- extinguishing thermoplastic material gray RAL 7035
- gaskets in anti-aging, oil-resistant, grease-resistant and fuel-resistant vinyl nitrile elastomer
- monoblock locking device in self- extinguishing thermoplastic material
- cable entry Pg (CK) or metric (MK)

CKA and MKA series

- made of die cast zinc alloy
- with epoxy-polyester powder coating
- gaskets in anti-aging, oil-resistant, grease-resistant and fuel-resistant vinyl nitrile elastomer
- monoblock locking device in galvanised steel
- cable entry Pg (CKA) or metric (MKA)

T-TYPE version

description

T-TYPE series

- **significant structural solidity** and mechanical robustness by virtue of **substantial thickness**;
- **resistance to the main chemical agents,** found in industrial environments;
- **pre-fastened gaskets** for easier installation;
- **external dimensions** of the bulkhead housing are **similar to those of the corresponding metal enclosures**; hole fixing centres **are unchanged**.
- **ample space** inside enclosures for cables, with mounted connectors, similar to the corresponding metal high construction versions;
- possibility of making completely **insulated constructions** (equivalent to Class II);
- **absence of powder paint** for environments in which these are not recommended;
- **non-electrostatic** thermoplastic material.
- degree of protection for coupled connectors is **IP65** (according to norm **IEC/EN 60529);**
- **UL Type 12** (= NEMA 12) degree of protection according to American standards **ANSI/UL 50** for indoor use;
- each enclosure carries its own part number and conformity markings;
- ambient temperature range: -40 °C / +90 °C.

COB

description

COB series

The COB system makes it possible to use multipole connectors within electric panels without the traditional metallic enclosure as protection is assured by the electric panel itself or other container.

The COB system may be assembled in the three following ways:

- on panels with window snap fastening device
- on DIN EN 60715 rails, both lengthways and crossways to the support
- on fixed panels using screws.

The COB system offers the following advantages:

- reduction in cost and space with respect to metallic enclosures and traditional terminal boards
- possibility of rewiring at the connector bench with connected devices
- easy wiring inspection and tests with coupled connectors, thanks to rear access to the inserts via the turnover device
- fast mounting in panels thanks to the snap fastening device on the DIN EN 60715 rails
- sturdy support structure, specific to the size of each insert and does not require any preparation
- broad passage for housing of conductor cables
- mobile parts prearranged for the clamping of bundles of conductors of multipolar cables to prevent contact with the connector contacts.