

GENERAL CATALOGUE

Appendix

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RECOMMENDED TIGHTENING TORQUE

- Insert terminal screws, including PE terminal and fixing screws
- Axial screw inserts, MIXO series CX 02 4A / CX 02 4B
- Enclosures assembly screws
- Enclosures locking screws

Insert terminal screws, including PE terminal and fixing screws

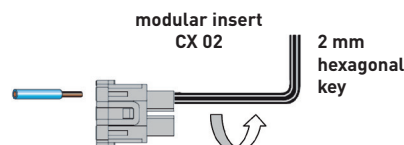
Increasing the tightening torque of terminal screws does not considerably improve the contact resistance. The screw torques are selected according to standard EN 60999-1, to provide excellent mechanical, thermal and electric behaviour. The conductor or terminal may be damaged if the recommended values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

Screw size	Connector type	Recommended tightening torque		Recommended size of screwdriver
		Nm	lb.in	
	LINE TERMINALS			
M2,5	CT 40, 64	0,4	3.5	0,5 × 3
M2,6	CT 06..24	0,4	3.5	0,5 × 3
M3	CK	0,5	4.4	0,5 × 3
M3	CDA	0,5	4.4	Ph0 or 0,6 × 3,5
M3	CNE, CME	0,5	4.4	Ph0 or 0,8 × 4
M3	CX 4/2, CX 4/8 (16A)	0,5	4.4	0,6 × 3,5
M3	CX 4/8 Q (16A)	0,5	4.4	Ph0
M4	CP	1,2	10.6	Ph1 or 0,8 × 4
M7	CX 02 4A /4B	1,5 – 2	13.3 – 17.7	2 mm hex
M6	CX 4/.. (80A)	2,5	22.1	1,0 × 5,5
M6	CX 01 YA /YPEA (for tubular cable lug)	3	26.5	Torx® T30
M8	CX 01 30A /30PEA (for tubular cable lug)	10	88.5	Torx® T45
	PE TERMINAL			
M3	CK, CQ 05, RQ 05, CQ 07, CQ 12	0,5	4.4	0,5 × 3
M4	all series except CD 15, CD 25, CDA, CDC, CSAH, MIXO	1,2	10.6	Ph2 or 1,0 × 5,5
M3,5	series CD 15, CD 25, CDA, CDC, CSAH	0,8	7.1	Ph1 or 0,8 × 5,5
M3	small PE terminal, MIXO frames series	0,5	4.4	Ph1 or 1,0 × 4,5
M4	large PE terminal, MIXO frames series	1,2	10.6	Ph1 or 1,0 × 5,5
M4	PE terminal, MIXO ONE and MIXO TWO enclosures	1,2	10.6	Ph1 or 1,0 × 5,5
	FASTENING SCREWS			
M3	CK, CKS, CKSH, CD 07, CDY 07, CD 08, CDY 08, CQ 05, CQY 05, RQ 05, CQ 07, CQ 12, CQ 21, CQ4 02 /02 H, CQ4 03 /03/2, CJ KF /KM, CJK 8FT /8MT /CJK 8IFT /8IMT /8B IFT /8P IFT, CJK 8M, CUK 2FT /3FT, CLK 04 SC, CX 1/2 BD	0,5	4.4	Ph1 or 0,8 × 5,5
M3	assembly screws MIXO CX 01 GPE	0,5	4.4	Ph1 or 0,8 × 4
M3	screw for fastening inserts or frames to enclosures of all series except T-TYPE, CK-MK, CKA-MKA, RKA, CQ-MQ 08, MIXO ONE and MIXO TWO	0,8	7.1	Ph1 or 0,8 × 4
Ø 2,9	screws for fastening 32.13 inserts CQ 04/2, CQ 08, CQ 08E, CQY 08E, CQ 17 to CQ-MQ 08 and CQA-MQA 08 enclosures	0,7	6.2	Ph1
M3	screw for fastening inserts to T-TYPE enclosures	0,5	4.4	Ph1 or 0,8 × 4
Ø 2,9	series MIXO ONE enclosures, assembly of top and bottom parts	0,8	7.1	Ph1
	series MIXO TWO enclosures	0,8 – 1,2	7.1 – 10.6	3 mm hex
M4	CYR 16.3, CYR 24.4 cable pass-through hoods, assembly of two halves	1,2	10.6	Ph2 or 1,0 × 5,5
M4	CYG 16 in-line joint, assembly of two halves and mounting of two bulkhead mounting housings size 77.27	1,2	10.6	Ph2 or 1,0 × 5,5
M5	series BIG enclosures, assembly of top and bottom parts	1,0	8.8	Ph2

Axial screw inserts, MIXO series CX 02 4A / CX 02 4B

The connections of the conductors to the female and male inserts are made via axial screw. Fully insert the stripped wire in the back of the contact (axial screw terminals are supplied fully opened); while holding the wire down, insert a 2 mm hexagonal key in the front of the contact and tighten to recommended torque.

- Usable conductor cross-sections (EN 60228 class 5):
from 2,5 mm² to 8 mm² (14 AWG to 10 AWG) (CX 02 4AF/M)
from 6 mm² to 10 mm² (10 AWG to 8 AWG) (CX 02 4BF/M)
(extra-flexible EN 60228 class 6: 2,5 mm² ... 6 mm² (14 AWG to 10 AWG))
- Use only stranded flexible copper conductors
- Do not twist the strands!
- Tightening torque with 2 mm hexagonal Allen key:
1,5 Nm (13,3 lb.in) max for conductors with cross-section 2,5 mm² ... 4 mm² (14 AWG to 12 AWG)
2 Nm (17,7 lb.in) max for conductors with cross-section 6 ... 10 mm² (10 AWG to 8 AWG)
- Stripping length: 8+1 mm



Enclosures assembly screws

In the table below, the recommended minimum and maximum tightening torque to apply to the fixing screws of ILME bulkhead mounting housings are shown, assuming the use of steel screws with 8.8 resistance class and a good fixing panel surface according to the requirements mentioned therein.

Series	Number of screws	Screw size	Recommended torque		Flange sealing element
			Nm	lb.in	
CK /MK, CKX, CKA /MKA, CQ	2	M3	0,8 – 1,0	7.1 – 8.9	Gasket
CK 03 IA4, MK AP /IAP with M25 cable entry	4	M3	0,6 – 0,7	5.3 – 6.2	Gasket
CKA 03 IA4, MKA AP /IAP with M25 cable entry	4	M3	0,8 – 1,0	7.1 – 8.9	Gasket
MIXO ONE	4	M3	0,5 – 0,9	4.4 – 8.0	Gasket
MIXO TWO (bulkhead mounting)	2	M4	0,8 – 1,2	7.1 – 10.6	Gasket
MIXO TWO (surface mounting)	4	M4	0,8 – 1,2	7.1 – 10.6	Gasket
CZI 15 /25	4	M3	0,8 – 1,0	7.1 – 8.9	Gasket
CHI 50	4	M4	1,2 – 1,8	10.6 – 15.9	Gasket
CHI 06 /10 /16 /24	4	M4	0,8 – 1,2	7.1 – 10.6	Gasket
CHI 32	4	M4	1,2 – 1,8	10.6 – 15.9	Gasket
CHI 48	4	M6	3,0 – 3,6	26.6 – 31.9	Gasket
CGK /MGK (IP68)	2	M4	0,8 – 1,2	7.1 – 10.6	O-ring
CGI /MGI 06 /10 /16 /24 (IP68)	2	M6	3,0 – 3,6	26.6 – 31.9	O-ring
T-TYPE, T-TYPE /H, T-TYPE /C, T-TYPE /W	4	M4	0,8 – 1,2	7.1 – 10.6	Gasket
BIG series hoods with integrated special self-centring floating frame	4	M5	2,0 – 2,5	17.7 – 22.1	–

To guarantee the declared IP degree of protection of the housings reported in this catalogue, according to EN IEC 60529 or to the relevant Type rating per ANSI/UL 50 and 50E (for those products bearing approval to those ratings), the surface of the mounting panel must meet the following requirements (definitions are provided in ISO 4287 standard):

- Waviness $W_t \leq 0,2$ mm over a distance of 200 mm (measured on the panel without load)
- Roughness $R_a \leq 16$ μ m

NOTE: The values of tightening torque indicated in the above table are just recommended values, that must be related – by the designer of the final application – to the resistance class of the screws (not included in the delivery), with the assumption that the mounting panel is sufficiently rigid (stiff). If the deflection of the panel, under the effect of tightening the screws, is greater than 0,7 mm over a distance of 100 mm, it is necessary to use the counter-flanges mentioned in our catalogue or the special flange gaskets available upon request (please contact our Sales Department). For the CGI /MGI IP68 enclosures the specific counter-flanges mentioned in our catalogue are always recommended.

Enclosures locking screws

Series	Number of screws	Screw size	Recommended tightening torque		Recommended size of screwdriver
			Nm	lb.in	
CGK /MGK	2	M4	1,2	10.6	1,0 × 5,5 or 7 mm hexagonal key
CG /MG	2	M6	2,5	22.1	1,6 × 10 or 10 mm hexagonal key

RANGE OF CONDUCTOR CROSS-SECTIONAL AREA AND STRIPPING LENGTH

Connector inserts	Range of conductor cross-sectional area		Stripping length
Connection technology			
Screw	mm²	AWG	mm
CK	0,75 – 2,5	18 – 14	6
CX 4/2, CX 4/8 (16A poles) ¹⁾	0,75 – 4	18 – 12	7
	0,75 – 2,5	18 – 14	7
CNE ¹⁾	0,5 – 4	20 – 12	7
CNE..X	0,25 – 2,5	24 – 14	7
CDA ¹⁾	0,5 – 4	20 – 12	7
CDA..X	0,25 – 2,5	24 – 14	7
CT 06..24	0,75 – 2,5	18 – 14	12
CT 40 and 64	0,75 – 2,5	18 – 14	12
CME ¹⁾	0,5 – 4	20 – 12	7
CME..X	0,5 – 2,5	20 – 14	7
CP ¹⁾	0,75 – 6	18 – 10	10,5
CX 4/.. (80A poles)	4 – 16	12 – 5	14
MIXO CX 01 YA /YPEA (for tubular cable lug)	10 – 70	6 – 2/0	3)
MIXO CX 01 30A /30PEA (for tubular cable lug)	10 – 120	6 – 4/0	3)
Crimp			
MIXO (5A), CX 25 IB	0,08 – 0,75	28 – 18	4
CQ 21	0,08 – 0,5	28 – 20	4
CDD, CD, MIXO (10 A), CQ 12, CQ 07	0,14 – 2,5*	26 – 14	8 / *6 for 2,5 mm²
CCE, CDC, CMCE, CQ, CQE, CQEE, MIXO (16 A)	0,14 – 4	26 – 12	7,5
CX, MIXO (40 A), CQ4 03	1,5 – 2,5	16 – 14	9
	4 – 6	12 – 10	9,6
	10	8	15
CX 4/.., RX 4/.. (80 A) MIXO (70 A)	10 – 25	7 – 4	15
MIXO (100 A), CX 6/6	10 – 35	7 – 2	15
MIXO (200 A)	16 – 70	6 – 2/0	15
MIXO (300 A)	16 – 25	6 – 4	19
	35	2	20
	50 – 120	1 – 4/0	22,5
Spring			
CSE, CSH, CTSE 06..24, CMSH, MIXO [CX 05 S ²⁾ , CX 05 SH], CSS	0,14 – 2,5	26 – 14	9 – 11
MIXO CX 06 CY, CX 08 CY, CQY 05, CQY 08E CQEY 10..46 (AXYR®)	0,25 – 4 un-ferruled 0,25 – 2,5 ferruled	22 – 12 un-ferruled 22 – 14 ferruled	9 – 11
CTS 40/64	0,14 – 2,5 un-ferruled 0,14 – 1 ferruled	26 – 14 un-ferruled 26 – 18 ferruled	9 – 11
CKS, CKSH, CDS, CDSH, CSAH, CDY 07 /08 (AXYR®), MIXO CX 12 DY (AXYR®)	0,14 – 2,5 un-ferruled 0,14 – 1,5 ferruled	26 – 14 un-ferruled 26 – 16 ferruled	9 – 11

¹⁾ For CNE, CDA, CP, CME, "CX 4/8 – pole 16A" series connectors with screw terminal and conductor protection plate, the use of ferrules is not necessary (= un-ferruled conductor).
The use of ferrules (= ferruled conductor) causes a reduction in maximum useful cross-section to the lower size (e.g. 4 mm² un-ferruled - 2,5 mm² ferruled).

²⁾ Available upon request.

³⁾ Stripping length according to tubular cable lug specification.

LOAD CURVES

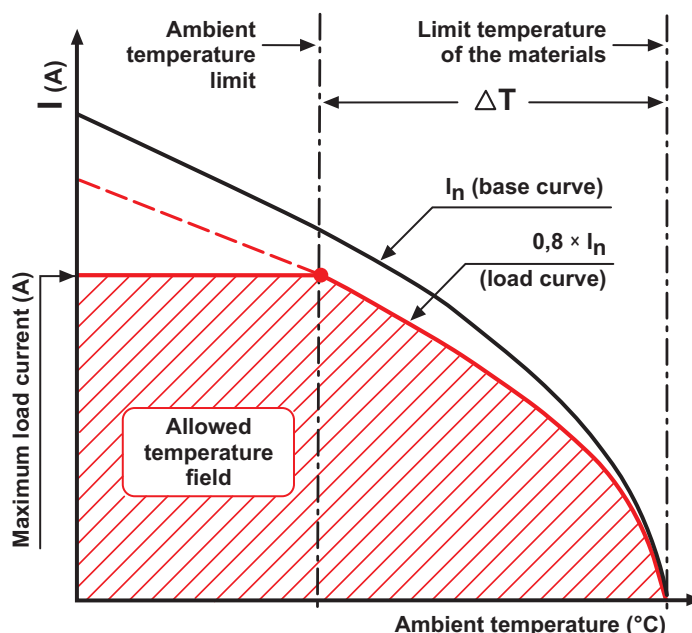
The permitted current-carrying capacity for connectors is variable: it decreases with the increase of the number of poles and of the ambient temperature in which the connector is installed and it depends upon the thermal properties of the material used for the contacts and the insulating parts, including that of the type of wiring used. The current-carrying capacity is obtained from the load curves which are constructed according to standard IEC 60512-5-2, for currents simultaneously circulating through all poles.

The limit current curves express current values of current that determine the achievement of the upper limiting temperature (ULT) of the materials. The choice of the permanent load applicable on the contacts **must be made within the possible field of operation possible delimited by the above-mentioned curves.**

Since use of connectors at the limit values of their characteristics is not recommended, the **base curve** is de-rated. The reduction of the load currents to 80% defines the correction curve, where both the maximum permissible contact resistances and the inaccuracy of the temperature measurements are sufficiently taken into consideration.

The correction curve represents the final **limit current curve (load curve)** as defined by standard IEC 60512-5-2. It therefore takes into consideration the differences between the various connector inserts, as well as errors in the temperature measurements.

All the load curves presented in this catalogue include the correction. See figure below.



Legend

Maximum load current (A)

Value for which the connector reaches the upper limit temperature of the material at the corresponding ambient temperature intersected on the load curve.

Limit temperature of the materials

Value determined by the characteristics of the material used. The sum of the ambient temperature and the increase of the ΔT (temperature rise) caused by the current flow shall not exceed the limit temperature of the materials.

Ambient temperature limit

The environmental conditions shall not exceed this value. It may be known and determines the maximum allowed load current, or it may be directly obtained from the load curve.

Base curve

Set of current and temperature values obtained from laboratory tests and influenced by the connector's characteristics (number of poles, constructional shape, thermal conductivity of the materials, etc.) and the cross-section of the conductor used.

Load curve (limit current curve)

Obtained from the base curve via the safety coefficient.

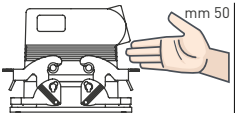
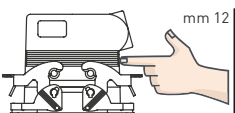
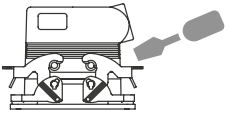
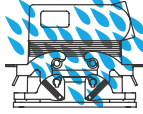
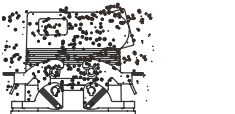
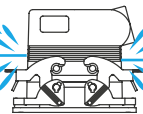
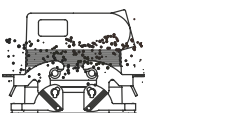
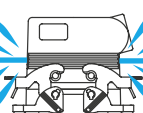
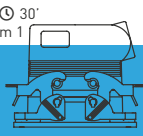
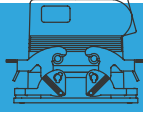
ΔT (temperature rise)

Temperature rise produced by a permanent current circulating through all the poles of a connector coupling; difference between the upper limiting temperature (ULT) of the material and the ambient temperature obtained on the limit current curve.

DEGREE OF PROTECTION

The connector's housing, sealing and locking mechanism protect the connection from external influences such as mechanical shocks, foreign bodies, humidity, dust, water or other fluids such as cleansing and cooling agents, oils, etc. The degree of protection the housing offers is explained in the IEC 60529, DIN EN 60529, standards that categorize enclosures according to foreign body and water protection.

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.

FIRST Index figure	Degree of protection SOLIDS		SECOND Index figure	Degree of protection WATER	
0		No protection	0		No protection
1		Protected against access to hazardous parts with the back of a hand and protected against solid foreign objects of Ø 50 mm and greater	1		Protected against vertically falling water drops
2		Protected against access to hazardous parts with a finger - protected against solid foreign objects of Ø 12,5 mm and greater	2		Protected against vertically falling water drops when enclosure tilted up to 15° (on either side of the vertical)
3		Protected against access to hazardous parts with a tool - protected against solid foreign objects of Ø 2,5 mm and greater	3		Protected against spraying water (at an angle up to 60° on either side of the vertical)
4		Protected against access to hazardous parts with a wire - protected against solid foreign objects of Ø 1,0 mm and greater	4		Protected against splashing water from any direction
5		Protected against access to hazardous parts with a wire dust-protected (no harmful dust deposit)	5		Protected against water jets from any direction
6		Protected against access to hazardous parts with a wire dust-tight (total protection against dust)	6		Protected against powerful water jets from any direction (similar to sea waves)
RATING EXAMPLE IP 65			7		Protected against the effects of temporary immersion in water at a maximum depth of 1 metre for 30 min
			8		Protected against the effects of continuous immersion in water at depth and/or duration upon agreement, more severe than for numeral 7
			9		Protected against high pressure and temperature water jets from any direction

IP (Ingress Protection) Ratings Guide table

Description according to IEC 60529

CHANGEOVER FROM PG THREADS TO METRIC

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 50262:1998** “Metric cable glands for electrical installations” has been in force since 1st January 2000. On 2016-09-23, **EN 62444:2013**, a modified version of IEC 62444:2010, finally replaced EN 50262 to cover with a broader scope, dimensions of metric cable glands with range M6 through M110, and as a guide even other type of entry threads of “Cable glands for electrical installations”.

The original **EN 50262:1998** standard defined new sizes with metric threads for cable glands according to **EN 60423** and established the safety prescriptions. However, it did not specify all cable glands' dimensions: the span size of the tightening wrench, the diagonal dimension, or those of the sealings providing tightness to dust and liquids were left void of standardization, whereas the withdrawn DIN standards for Pg cable glands did cover any of such operational details. The standard came mandatorily into force on 1st April 2001, when the contrasting national standards were withdrawn.

EN 62444 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 glands.

In the meantime, **EN 61076-7-100:2006** “Connectors for electronic equipment – Product requirements – Part 7-100: Cable outlet accessories – Detail specification for a metric cable sealing consisting of an integrated part of heavy-duty rectangular or circular connector hoods and a sealing system” was published, providing dimensional requirements, application information and tests for metric cable sealing of heavy-duty rectangular or circular connector hoods (sized M12 × 1,5 through M50 × 1,5) to cover cable outlets comprising all the necessary parts designed to fulfil the specific degree of sealing of the hood that are not cable glands (i.e. that are not covered by EN 62444).

Cable gland producers have introduced the new metric series to add to the Pg size series, to gradually replace the latter type. The transitional period indicated in the new standard should have ended on 1st March 2001, after which date the use of cable entry devices with Pg thread 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 mandatory **CE** marking of these items, observance of the safety conditions specified by the Low Voltage Directive is sufficient, however adherence to the safety requirements of EN 62444 provides presumption of conformity.

✍ **To distinguish hoods and surface-mounting housings with metric entries from the relevant Pg versions (identified with a “C” pre-code), the ILME metric types are identified with an “M” pre-code. The transposition table below provides the correspondence rule adopted in most cases by ILME for creating the new metric versions.**

Pg → metric transposition table

Pg	Metric
Pg 11	M20
Pg 13.5	M20
Pg 16	M20
Pg 21	M25
Pg 29	M32
Pg 36	M40
Pg 42	M50
Pg 48	M63

Cable diameter for use with ILME cable glands

Series	Metric thread					
	20	25	32	40	50	63
AS M..P	6 - 12,5	10 - 18	14 - 24	15 - 24	23 - 30	26 - 35
AS M..E	8 - 12,5	13,5 - 18	17 - 24	—	—	—
AG M..T	6 - 8 - 10	11 - 14 - 17	19 - 21 - 24	26 - 29 - 32	35 - 38 - 41	—
AG M..I	5 - 12,5	9 - 18	14 - 25	18 - 32	24 - 38,5	—
AG M..R	6 - 8 - 10	11 - 14 - 17	19 - 21 - 24	—	—	—

For more information, please refer to the technical catalogue on www.ilme.com

T-TYPE ENCLOSURES

RESISTANCE TO CHEMICALS COMPARISON TABLE

The classification herewith provided is only a generic reference guide in order to enable a first selection. It is based on literature data provided by the suppliers of the raw materials used, which are related to tests carried out on specimens under test conditions which are not always homogeneous and involving accelerating techniques, therefore not necessarily describing real operational conditions. The actual behaviour of products in the field may therefore be positively or negatively

influenced by several variable environmental parameters such as temperature, relative humidity, simultaneous presence of a plurality of substances and their concentration, exposure time, dynamic or static application condition, and so on. The accuracy of transferring the indications given herein to the actual conditions of use is therefore merely indicative and does not imply any guarantee or responsibility by ILME.

	T-TYPE	T-TYPE/W	T-TYPE/H	T-TYPE/C
A				
Acetone (propanone)	x	x	x	x
Active chlorine	x	x	x	x
Alum	●	●	●	●
Ammonia, 10% aqueous solution	●	x	●	●
Ammonia, liquid	x	x	●	●
Ammonium acetate	●	x	●	●
Ammonium carbonate	●	●	●	x
Ammonium chloride	●	●	●	x
Ammonium nitrate	●	●	●	●
Ammonium phosphate	●	●	●	●
Ammonium sulphate	●	●	●	●
Amyl alcohol	□	□	□	x
Aniline	□	□	x	x
Aqua regia (1:3 nitric acid : hydrochloric acid)	x	x	x	x
Asphalt	□	□	□	x

B				
Beer	●	●	●	●
Benzene	x	□	x	x
Borax	□	□	□	□
Boric acid	●	●	●	●
Boric acid, 10% aqueous solution	●	●	●	●
Boric water (boric acid 3%)	●	●	●	●
Butane, gas	□	□	□	x
Butane, liquid	□	□	□	x

C				
Calcium chloride	●	●	●	●
Calcium chloride, 10% aqueous solution	●	●	●	●
Calcium chloride, diluted suspension	●	●	●	●
Calcium nitrate	●	●	●	●
Calcium sulphate	●	●	x	●
Caustic potash (potassium hydroxide) 10%	x	●	●	x
Citric acid 50% aqueous solution	x	x	●	●
Copper sulphate 10% aqueous solution	●	●	●	●
Cresol	□	□	x	x
Cresolic solution	□	□	x	x
Cutting oil	□	□	□	x
Cyclo-hexane	□	□	□	x

D				
Deca-hydro-naphtalene	x	x	x	x
Di-Ethylhexyl Phthalate	●	x	x	x
Di-isononyl Phthalate	●	x	x	x
Di-octyl Phthalate	●	●	x	x
Diesel Oil	□	□	□	□
Diluted Glucose	●	●	●	●

	T-TYPE	T-TYPE/W	T-TYPE/H	T-TYPE/C
D				
Diluted Glycerine	●	●	●	●
Diluted Glycol	●	●	●	●
Diluted Phenol	□	□	x	x
Diluted urea	●	●	●	●

E				
Ethanol (ethyl alcohol)	x	x	●	●
Ethyl alcohol, 10% aqueous solution	●	●	●	●
Ethylene-glycol or propylene-glycol	●	●	●	●

F				
Fatty acids	●	●	●	□
Ferric chloride, 10% aqueous solution	x	x	x	x
Formalin (formaldehyde 40% aqueous solution)	x	x	●	●
Fruit juices	●	●	●	●
Fuel oils	□	□	□	x

G				
Gaseous ammonia	□	x	●	●
Gaseous propane	x	●	●	x
Glycerine	●	●	●	●
Grinding oil	□	□	□	x
Gypsum (see calcium sulphate)	●	●	x	●

H				
Heptane	□	□	□	x
Hexane	□	□	□	x
Hydrochloric acid, <2% aqueous solution	x	x	●	□
Hydrogen sulphide	□	x	●	x

I				
Ink	●	●	●	●
IRM oil 901	●	●	●	●
IRM oil 902	□	●	●	x
IRM oil 903	x	□	□	□
Isopropyl alcohol	□	●	●	●

K				
Kitchen salt, aqueous solution	●	●	●	●

L				
Lactic acid	●	●	●	●
Linseed oil	●	●	●	●
Liquid soap	x	●	●	●
Lubricating engine oil	□	□	□	x
Lubricating oil	●	●	●	x

NOTE: As the characterizing element of the T-TYPE/W series is the different sealing gasket material, hoods and covers without sealing gaskets for this series are the same of T-TYPE Standard.

	T-TYPE	T-TYPE/W	T-TYPE/H	T-TYPE/C
M				
Mercury	●	●	●	●
Methanol (methyl alcohol)	x	x	●	●
Methyl alcohol, diluted 50%	□	□	●	●
Mineral based oil	●	●	●	●
Mineral oils (un-tasteful)	●	●	●	●
Mothballs (naphthalene, paradichlorobenzene)	□	□	x	x
Muriatic acid, concentrated	x	x	x	x

N				
n-Butanol (butyl alcohol)	●	●	●	●
Naphthalene	□	●	x	x
Normal (low octane) gasoline (petrol)	□	□	□	x

O				
Octane	□	□	□	x
Oleic acid	●	●	●	x
Oxalic acid	●	●	●	●
Ozone	x	x	x	□

P				
Paraffin oil	●	●	●	●
Petrol ether	□	□	□	□
Petroleum	●	●	●	●
Petroleum spirit (dry cleaning)	□	□	x	x
Potassium carbonate	●	●	●	●
Potassium chlorate	●	●	x	●
Potassium chloride	●	●	●	●
Potassium cyanide, aqueous solution	●	●	●	●
Potassium di-chromate	□	□	●	●
Potassium iodide	□	□	●	●
Potassium nitrate	□	x	x	●
Potassium persulphate	□	□	x	●
Potassium sulphate	□	□	●	●

S				
Sea water	●	●	●	●
Silicon oil	●	●	●	x
Soap solution	□	●	●	●
Sodium bicarbonate (oxide)	●	●	●	●
Sodium carbonate (washing soda)	●	●	●	●
Sodium chlorate	●	●	x	●
Sodium chloride (kitchen salt)	●	●	●	●
Sodium bisulphate, aqueous solution	●	●	●	●
Sodium hydroxide (caustic soda)	x	x	●	●
Sodium hydroxide 12,5% (liscivia)	□	x	●	●
Sodium Hypochlorite	x	x	●	●

	T-TYPE	T-TYPE/W	T-TYPE/H	T-TYPE/C
S				
Sodium nitrate	●	●	●	x
Sodium nitrite	□	□	●	x
Sodium perborate	●	●	●	●
Sodium phosphate	●	●	●	x
Sodium silicate	●	x	x	●
Sodium sulphate	●	●	●	●
Sodium sulphide	●	●	●	●
Sodium Thiosulphate (photographic fixer)	●	●	●	●
Solution for photographic processing	●	●	●	●
Starch, aqueous (amylum)	●	●	●	●
Stearic acid	●	●	●	●
Succinic acid (butanedioic acid)	●	●	●	●
Sulphur	●	●	x	x
Sulphur dioxide (sulphurous anhydride)	□	x	x	□
Sulphuric acid, 2% aqueous solution	x	x	□	□

T				
Tallow	●	●	●	●
Tar	□	□	x	□
Tartaric acid	●	●	●	●
Toluene	x	x	x	x
Transformer oil (dielectric)	●	●	●	●
Trichloroethylene	x	x	x	x
Tricresyl phosphate	●	●	x	x
Turpentine essence	x	□	□	x

U				
Urine	●	●	●	●

V				
Vegetable oil	●	●	●	●
Vinegar	x	□	●	□

W				
Water	●	●	●	●
White alcohol (isopropanol + ethanol)	□	●	●	●

X				
Xylene	x	x		

Legend

● : Resistant □ : Limited resistance x : Not resistant

DIMENSIONING OF CLEARANCES – 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 in regard to 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 above 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 INTRO.22-31. 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 60038²⁾ and some concepts were taken from the regulations for LV electrical systems of the IEC 60364³⁾ series, such as:

- the **overvoltage category** (I, II, III, IV), according to the use of the equipment⁴⁾: this is correlated with the transient overvoltages taken as a basis for determining the rated impulse voltage;
- the **pollution degree** (1, 2, 3);
- the **material group** (I, II, III) classification of insulating materials according to their resistance to tracking;
- 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.

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). Being a dated reference in EN 61984:2009, this is still the edition of reference, however, the latest edition Ed.3.0 is IEC 60664-1:2020-05 + IEC 60664-1/COR1:2020-10, harmonized in EU as EN IEC 60664-1:2020-07 + EN IEC 60664-1/AC:2020-12.

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.

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 Three-phase ^{a)}	V Single phase		I	II	III	IV
		≤ V				
		50	330	500	800	1 500
		100	500	800	1 500	2 500
	120-240	150	800	1 500	2 500	4 000
230/400 277/480		300	1 500	2 500	4 000	6 000
400/690		600	2 500	4 000	6 000	8 000
1 000		1 000	4 000	6 000	8 000	12 000

a) The "I" 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.

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 $\geq$ 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 $\geq$ 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 $\geq$ 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 $\leq$ CTI
group II	400 $\leq$ CTI < 600
group IIIa	175 $\leq$ CTI < 400
group IIIb	100 $\leq$ 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:

- 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);
- the overvoltage category (usually III).
- The rated impulse voltage determined from Table B.2 of IEC 60664-1 (usually 4 kV or 6 kV).
- 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.				
					V			
					Overvoltage category			
	V	V	V	V	I	II	III	IV
50			12,5 24 25 30 42 48	30-60	330	500	800	1 500
100	66/115	60	60		500	800	1 500	2 500
150	120/208 ²⁾ 127/220	115, 120, 127	100 ³⁾ , 110, 120	100/- 200 ²⁾ 110-220 120-240	800	1 500	2 500	4 000
300	220/380, 230/400, 240/415, 260/440, 277/480	200 ³⁾ , 220, 230, 240, 260, 277	220	220-440	1 500	2 500	4 000	6 000
600	347/600 380/660 400/690 417/720 480/830	347, 380, 400, 415, 440, 480, 500, 577, 600	480	480-960	2 500	4 000	6 000	8 000
1 000		660 690, 720 830/1000	1 000		4 000	6 000	8 000	12 000

1) These columns are taken from Table F.1 indicating the rated impulse withstand voltages.

2) Used in the United States and Canada.

3) 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 U_{imp} 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 ³⁾	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 ⁴⁾	50	-
60	63	-
30-60	63	32
100 ⁴⁾	100	-
110	125	-
120	125	-
150 ⁴⁾	160	-
220	250	-
110-220	250	125
120-240	250	125
300 ⁴⁾	320	-
220-440	500	250
600 ⁴⁾	630	-
480-960	1000	500
1000 ⁴⁾	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.

3) It is assumed that the rated voltage of the equipment is not less than this value.

4) 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 ³⁾	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 ⁴⁾	160	-	160
208	200	125	200
220	250	160	250
230	250	160	250
240	250	160	250
300 ⁴⁾	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 ⁴⁾	630	-	630
660	630	400	630
690	630	400	630
720	800	500	800
830	800	500	800
960	1000	630	1000
1000 ⁴⁾	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						
			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 IIb 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 (Cr⁶⁺)** (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 e 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. Current editions are:

- **EN 45545-1:2013**, Railway applications – Fire protection on railway vehicles – Part 1: General
- **EN 45545-2:2020+A1:2023**, Railway applications – Fire protection on railway vehicles – Part 2: Requirements for fire behaviour of materials and components
- **EN 45545-3:2024**, Railway applications – Fire protection on railway vehicles – Part 3: Fire resistance requirements for fire barriers
- **EN 45545-4:2024**, Railway applications – Fire protection on railway vehicles – Part 4: Fire safety requirements for rolling stock design
- **EN 45545-5:2013+A1:2015**, 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
- **EN 45545-6:2013**, Railway applications – Fire protection on railway vehicles – Part 6: Fire control and management systems
- **EN 45545-7:2013**, Railway applications – Fire protection on railway vehicles – Part 7: Fire safety requirements for flammable liquid and flammable gas installations

The standard, whose most recent issues are at 2nd edition, 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 ceased 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 was EN 45545:2013, and the subsequent new edition depending on the relevant date of entry into force with a period of grace as defined in each document. 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** = Hazard Level).

See Table 1 – Hazard level classification (EN 45545-2:2020).

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 m², 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 CITNLP). **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 × 70 100** Analyse de gaz de pyrolyse et de combustion;
- **NF × 10 702** Détermination de l'opacité des fumées en atmosphère non renouvelée.

Table 1 – Hazard level classification (EN 45545-2:2020)

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 × 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 D_s max (flaming) = 117 and a smoke toxicity index CIT_{NLP} = 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



ILME enclosures have been certified by UL as Recognised Components for the USA and Canada (UL US mark) as accessories of our set of UL and CSA ECBT2/ECBT8 certified connector inserts (file UL E115072, file CSA 082270_0_000). Such enclosures serve as well as accessories for the UL US certified connector inserts in our file E506437 for the PVVA2/PVVA8 product category (UL 2237).

The certification has been achieved by successfully completing several tests carried out in compliance with standard **ANSI/UL 50**, Enclosures for Electrical Equipment and **ANSI/UL 50E** Enclosures for Electrical Equipment, Environmental Considerations which are equivalent to the North American voluntary standard **NEMA 250** (NEMA = National Electrical Manufacturers 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.

Type 4 and Type 4X ratings are now also possible for indoor use only according to **UL 508** and **UL 2237**, for insulating enclosure which are then not required to pass tests for exposure to ultraviolet radiation (which is required for outdoor applications).

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 **DE**centralised and **Standardised INst**allation 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 / CDY inserts, 8 poles, CSAH / CDA / CDC inserts, 10 poles.
- EUROMAP 27-1: MIXO inserts, CX 08 C / CY and CX 04 B.
- EUROMAP 28: CNE / CCE / CSH / CSE / CSS inserts, 6 poles.
- EUROMAP 29: CNE / CCE / CSH / CSE / CSS 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 / DY.
- EUROMAP 71: CD inserts, 50 poles (CD 25 Z version).
- EUROMAP 73: MIXO inserts, CX 12 D / DY.
- EUROMAP 74: MIXO inserts, CX 12 D / DY.
- EUROMAP 78: MIXO inserts, CX 12 D / DY.
- EUROMAP 81.1: MIXO inserts CX 08 C / CY
- EUROMAP 81.2: MIXO inserts CX 08 C / CX + CX 12 D / DY