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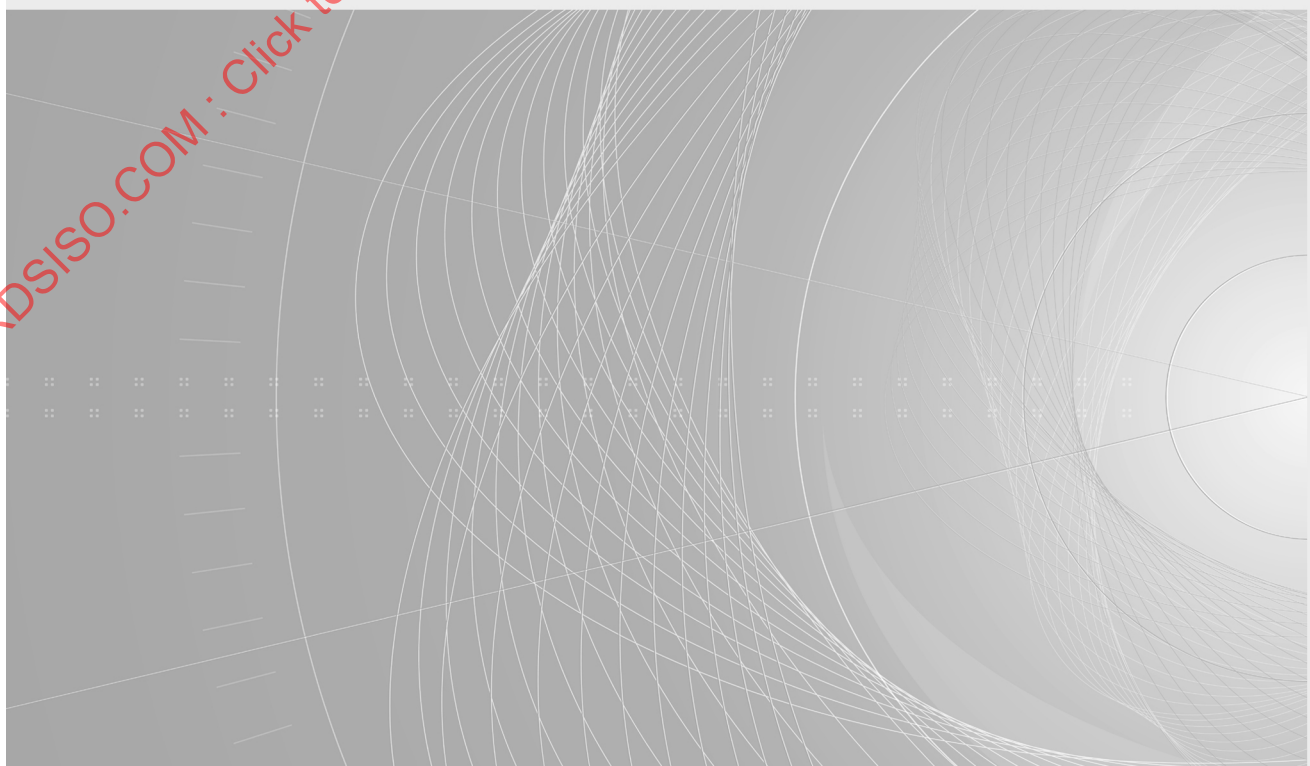
Edition 1.2 2019-07
CONSOLIDATED VERSION

TECHNICAL REPORT

Information technology – Generic cabling – Introduction to the MICE environmental classification



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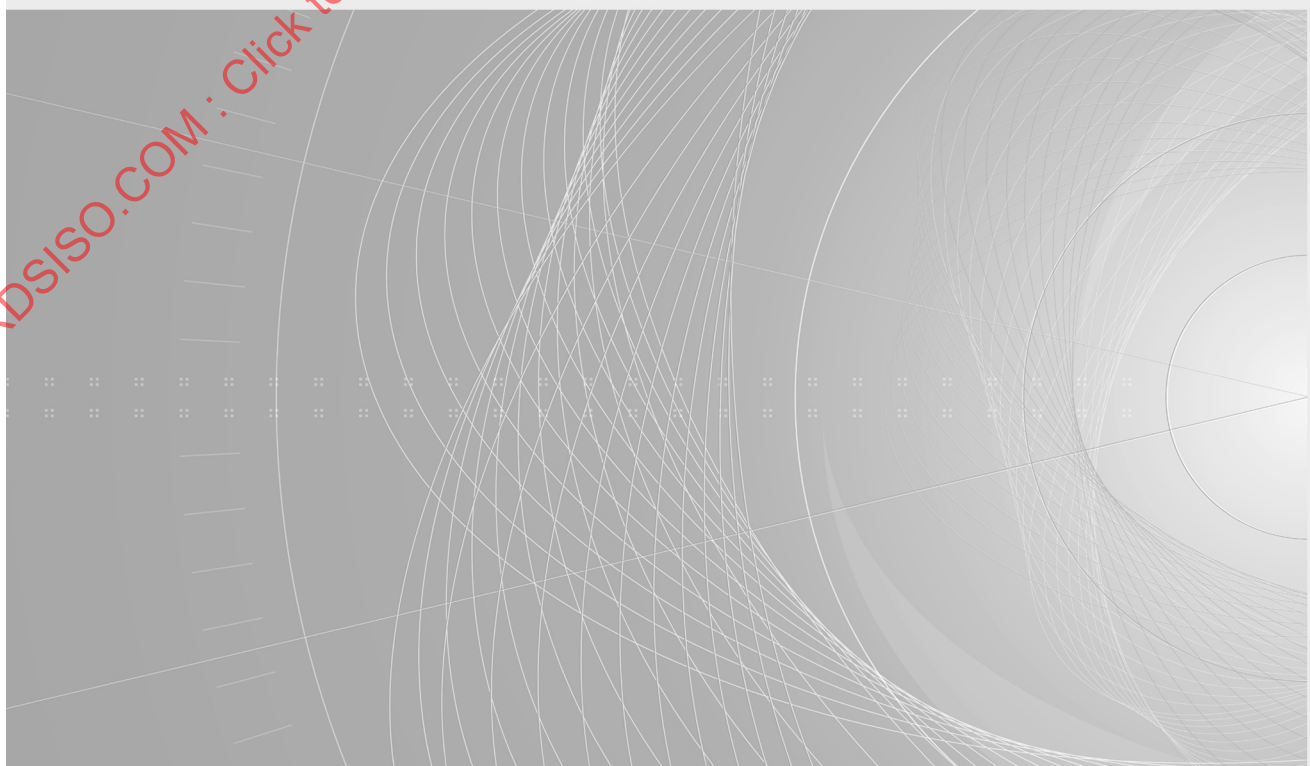

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INFORMATION TECHNOLOGY – GENERIC CABLING – INTRODUCTION TO THE MICE ENVIRONMENTAL CLASSIFICATION

FOREWORD

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ISO/IEC TR 29106 edition 1.2 contains the first edition (2007-11), its amendment 1 (2012-12) and its amendment 2 (2019-07) [documents JTC1-SC25/2836/DTR and JTC1-SC25/2853/RVDTR].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

The main task of IEC and ISO technical committees is to prepare International Standards. In exceptional circumstances, ISO/IEC JTC 1 or a subcommittee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where, for any other reason, there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when the technical committee has collected data of a different kind from that which is normally published as an International Standard, for example 'state of the art'.

ISO/IEC 29106, which is a Technical Report of type 3, has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

This Technical Report of type 3 has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION to Amendment 1

The Amendment has been developed to correct the misalignment of the MICE table with ISO/IEC 24702.

INFORMATION TECHNOLOGY – GENERIC CABLING – INTRODUCTION TO THE MICE ENVIRONMENTAL CLASSIFICATION

1 Scope

This Technical Report acts as an introduction to the concepts used to develop the MICE environmental classification system used in cabling standards developed by ISO/IEC. It also provides detailed explanation of the sources used to define the boundaries of MICE classifications.

2 Reference documents

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~ISO/IEC 11801, *Information technology – Generic cabling for customer premises*~~

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC 11801-2, *Information technology – Generic cabling for customer premises – Part 2: Office premises*

ISO/IEC 11801-3, *Information technology – Generic cabling for customer premises – Part 3: Industrial premises*

ISO/IEC 11801-4, *Information technology – Generic cabling for customer premises – Part 4: Single-tenant homes*

ISO/IEC 11801-5, *Information technology – Generic cabling for customer premises – Part 5: Data centres*

ISO/IEC 11801-6, *Information technology – Generic cabling for customer premises – Part 6: Distributed building services*

~~ISO/IEC 15018, *Information technology – Generic cabling for homes*~~

~~ISO/IEC 24702, *Information technology – Generic cabling – Industrial premises*~~

IEC 60068-2-5:1975, *Environmental testing – Part 2: Tests. Test Sa: Simulated solar radiation at ground level*

IEC 60654-4:1987 *Operating conditions for industrial-process measurement and control equipment. Part 4: Corrosive and erosive influences*

IEC 60721-1, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*

IEC 60721-3-3, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weatherprotected locations*

~~IEC 61000-2-5, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 5: Classification of electromagnetic environments. Basic EMC publication*~~

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61131-2, *Programmable controllers – Part 2: Equipment requirements and tests*

~~IEC 61326:2001, *Electrical equipment for measurement, control and laboratory use – EMC requirements*~~

IEC 61918, *Industrial communication networks – Installation of communication networks in industrial premises*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

~~For the purposes of this Technical Report the definitions of the applicable generic cabling standards ISO/IEC 11801, ISO/IEC 15018 and ISO/IEC 24702 apply.~~

For the purposes of this document, the terms and definitions of the applicable parts of ISO/IEC 11801 apply.

3.2 Abbreviations

~~For the purposes of this Technical Report the abbreviations of the applicable generic cabling standards ISO/IEC 11801, ISO/IEC 15018 and ISO/IEC 24702 apply.~~

For the purposes of this document, the abbreviations of the applicable parts of ISO/IEC 11801 apply.

4 Application of environmental classification

4.1 MICE

The term MICE referenced in generic cabling standards produced by ISO/IEC[1] relates to the classification of the environment of the cabling channel.

There are four primary environmental criteria used to classify an environment:

- the M element, defining the mechanical characteristics of the environment;
- the I element, defining the ingress protection characteristics of the environment;
- the C element, defining the climatic and chemical characteristics of the environment;
- the E element, defining the electromagnetic characteristics of the environment.

Each of the four primary environmental criteria are further divided into specific parameters and levels for those parameters. The MICE classification for a given location is therefore defined as $M_aI_bC_cE_d$ where a, b, c and d are the individual sub-classifications (levels) for the M, I, C and E criteria respectively.

[1] The documents prepared by subcommittee 25 of ISO/IEC joint technical committee 1: Information technology.

The suffixes for the four primary environmental criteria are either 1, 2 or 3. For example, the most benign environment is described as $M_1I_1C_1E_1$ whereas the most harsh environment within the scope of this standard would be defined as $M_3I_3C_3E_3$.

4.2 Channel environment

The applicable MICE classification may vary along the length of the cabling channel. As shown in the industrial premises cabling example of Figure 1, the ingress protection characteristics of the environment in the automation area and at the automation island are different from, and more severe than, those characteristics on the factory floor or in the telecommunications room.

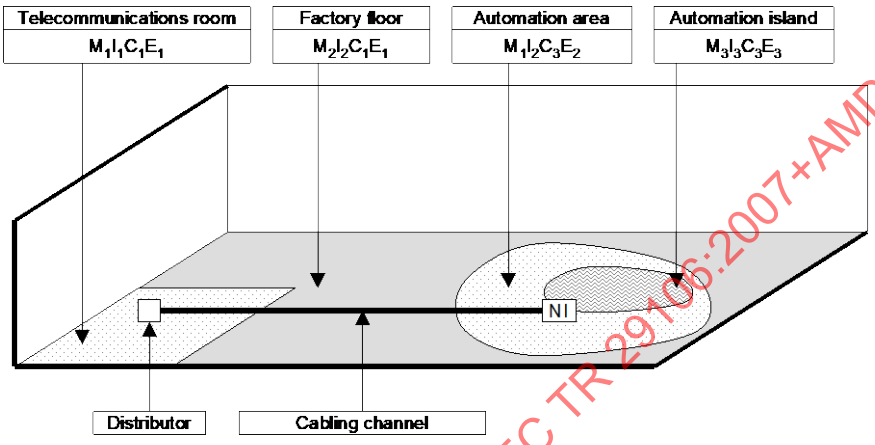

Figure 1 – Example of variation of the environment along an industrial premises cabling channel

The environment to be classified is that local to the cabling. Where no environmental protection is provided to the cabling, the classification of the local environment is also that of the overall environment at that location.

However, where technical or economic restrictions preclude the use of components compatible with the overall environment, mitigation or isolation techniques may be applied to modify one or more of the M, I, C or E environments local to the cabling in order to allow appropriate components to be installed.

The mitigation or isolation techniques typically involve the use of alternative pathways and/or pathway systems as shown in Figure 2.

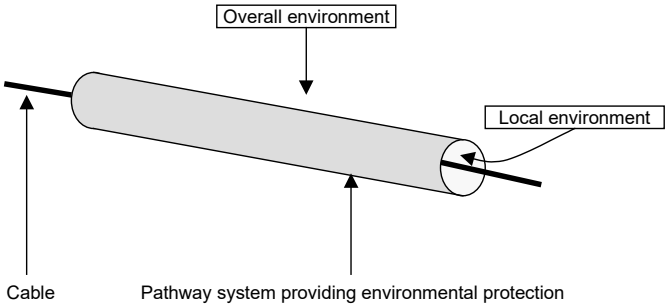

Figure 2 – The local environment

4.3 Component selection

The components used within a channel should be selected to be compatible with the MICE classification of the channel at the point where the components are to be installed.

Table 1, taken from ~~ISO/IEC 24702:2006~~ ISO/IEC 11801-1:2017, shows the parameters used to classify the local environment under the M, I, C and E criteria. While the classification of an environment is determined by the most demanding parameter within each criteria group, the selection of components may reflect the specific demands of all the parameters within the group, including those that may be less demanding than the overall classification of the environment.

The MICE classification system is intended to address approximately 80 % of the environments to which cabling may be subjected. There are some environments beyond the boundaries of $M_3I_3C_3E_3$. Such environments are beyond the scope of this Technical Report and require special handling.

Table 1 – Details of environmental classification

Mechanical	**M_1**	**M_2**	**M_3**
Shock/bump[a]			
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}
Tensile ~~force~~ strength	b	b	b
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Impact	1 J	10 J	30 J
Bending, flexing and torsion	b	b	b
Ingress	**I_1**	**I_2**	**I_3**
Particulate ingress (max. diameter)	12,5 mm	50 µm	50 µm
Immersion	None	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance and immersion (≤ 1 m for ≤ 30 min)
Climatic and chemical	**C_1**	**C_2**	**C_3**
Ambient temperature	−10 °C to +60 °C	−25 °C to +70 °C	−40 °C to +70 °C
Rate of change of temperature	0,1 °C per minute	1,0 °C per minute	3,0 °C per minute
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)
Solar radiation	700 Wm^{-2}	1 120 Wm^{-2}	1 120 Wm^{-2}
Liquid pollution[c] Contaminants	Concentration × 10^{-6}	Concentration × 10^{-6}	Concentration × 10^{-6}
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3
Oil (dry-air concentration) (for oil types see [b])	0	< 0,005	< 0,5
Sodium stearate (soap)	None	> 5 × 10^4 aqueous non-gelling	> 5 × 10^4 aqueous gelling

Detergent	None	ffs	ffs
Conductive materials	None	Temporary	Present
Gaseous pollution ~~(see b)~~[c] Contaminants	Mean / Peak (Concentration × 10^{-6})	Mean / Peak (Concentration × 10^{-6})	Mean / Peak (Concentration × 10^{-6})
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50
Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Sulphur trioxide (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Chlorine wet (> 50 % humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3
Chlorine dry (< 50 % humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0
Hydrogen chloride	– / < 0,06	< 0,06 / < 0,3	< 0,6 / 3,0
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250
Oxides of nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	< 5 / < 10
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1
Electromagnetic	**E_1**	**E_2**	**E_3**
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 µC)	8 kV	8 kV	8 kV
Radiated RF – AM	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	10 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
EFT/B (comms)	500 V	500 V	1 000 V
Surge (transient ground potential difference) – signal, line to earth	500 V	1 000 V	1 000 V
Magnetic field (50/60 Hz)	1 Am^{-1}	3 Am^{-1}	30 Am^{-1}
Magnetic field (60 Hz to 20 000 Hz)	ffs	ffs	ffs

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

[c] A single dimensional characteristic, i.e. concentration × 10^{-6}, was chosen to unify limits from different standards.

5 MICE system

5.1 General

The MICE concept is provided for the use of designers and planners to allow the specification of components to be purchased and/or protection (mitigation or isolation) required respectively.

Table 1 is not a basis for testing the local environment and neither is it a series of environmental criteria for the testing of components used within those environments. However, the limits describing the MICE classification system are in many cases based upon existing standards. Where such standards are not listed within Tables 2 to 6, no appropriate external references were identified during the development of ISO/IEC 11801-1.

5.2 Mechanical environment classification

Table 2 shows the derivation of the boundaries used in Table 1.

Table 2 – Derivation of boundaries for mechanical criteria in Table 1

Mechanical	M_1	M_2	M_3
Shock/bump[a]			
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}
Shock/bump/vibration (source material)	IEC 60721-3-3 Class 3M2	< IEC 60721-3-3 Class 3M6	IEC 60721-3-3 Class 3M8
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Impact	1 J	10 J	30 J
Bending, flexing and torsion	[b]	[b]	[b]

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

From IEC 60721-3-3:

3M1 applies to locations with insignificant vibration and shock.

In addition to the conditions covered by 3M1, 3M2 applies to locations with vibration of low significance (products mounted on light structures subject to negligible vibration).

In addition to the conditions covered by 3M5, 3M6 applies to locations where the level of vibration is high (e.g. close to heavy machines).

In addition to the conditions covered by 3M7, 3M8 applies to locations where the level of vibration is extremely high (e.g. products mounted on power hammers).

5.3 Ingress protection and climatic environment classification

Table 3 and Table 4 shows the derivation of the boundaries used in Table 1.

Table 3 – Derivation of boundaries for ingress protection criteria in Table 1

Ingress	I_1	I_2	I_3
Particulate ingress (dia. max.)	12,5 mm	50 μm	50 μm
Immersion	None	Intermittent liquid jet ≤12,5 l/min ≥6,3 mm jet >2,5 m distance	Intermittent liquid jet ≤12,5 l/min ≥6,3 mm jet >2,5 m distance and immersion (≤1 m for ≤30 min)

Table 4 – Derivation of boundaries for climatic criteria in Table 1

Climatic	C_1	C_2	C_3
Ambient temperature	−10 °C to +60 °C	−25 °C to +70 °C	−40 °C to +70 °C
	Existing ISO/IEC 11801	IEC 60721-3-3 Class 3K8H	IEC 60721-3-3 Class 3K7
Rate of change of temperature	0,1 °C per minute	1,0 °C per minute	3,0 °C per minute
	IEC 60721-3-3 Class 3K1	IEC 60721-3-3 Class 3K7	IEC 61131-2
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)
	IEC 60721-3-3 Class 3K3	IEC 60721-3-3 Class 3K4	IEC 60721-3-3 Class 3K5
Solar radiation	700 Wm^{-2}	1 120 Wm^{-2}	1 120 Wm^{-2}
	IEC 60721-3-3 Class 3K3 – 3K6	IEC 60721-3-3 Class 3K7. IEC 60068-2-5:1975 contains a table covering wavelengths from UV to IR that totals 1 120 Wm^{-2}.	

From IEC 60721-3-3:

3K1 applies to fully air-conditioned enclosed locations. Air temperature and humidity control is used continuously to maintain the required conditions. Installed products may be exposed to attenuated solar radiation and to movements of surrounding air due to draughts from the air-conditioning system. They are not subjected to heat radiation, condensed water, precipitation, water from sources other than rain, or formation of ice. These conditions may be found in a room of such construction that a confined range of temperature and humidity may be maintained.

In addition to the conditions covered by 3K1, 3K2 applies to continuously temperature-controlled enclosed locations. Humidity is not controlled. Heating, cooling or humidification is used where necessary to maintain the required conditions, especially where there is a large difference between them and the open air-climate. Installed products may be exposed to solar radiation and to heat radiation. They may be subject to movements of surrounding air due to draughts in buildings. These conditions may be found in manned offices, workshops and other rooms for special applications.

In addition to the conditions covered by 3K2, 3K3 applies to continuously temperature-controlled enclosed locations. Humidity is not controlled. Heating or cooling is used where necessary to maintain the required conditions, especially where there is a large difference between them and the open air-climate. These conditions may be found in normal living or

working areas, e.g. living rooms, rooms for general use (theatres, restaurants, etc.), offices, shops, workshops for electronic assemblies and other electrotechnical products, telecommunications centres, storage rooms for valuable and sensitive products.

In addition to the conditions covered by 3K3, 3K4 applies to temperature-controlled enclosed locations with a wide range of relative humidity. Humidity is not controlled. Installed products may be subject to condensed water and to water from sources other than rain. These conditions may be found in certain living or working areas, e.g. kitchens, bathrooms, workshops with processes producing high humidity, certain cellars, ordinary storage rooms, stables, garages. For the more humid open-air climates they may also be found in living rooms and rooms for general use.

In addition to the conditions covered by 3K4, 3K5 applies to enclosed locations having neither temperature nor humidity control. Heating may be used to raise low temperatures, especially where there is a large difference between them and the open air-climate. A product may be subject to the formation of ice. These conditions may be found in some entrances and staircases of buildings, garages, cellars, certain workshops, buildings in factories and industrial process plants, certain telecommunications buildings, ordinary storage rooms for frost-resistant products, farm buildings, etc.

In addition to the conditions covered by 3K4, 3K6, 3K7 and 3K8H apply to weather-protected locations having neither temperature nor humidity control. The locations may have openings to the open-air. The climatic conditions may be affected by the open-air climate and the type of building. Installed products may be exposed to solar radiation. They may also be subject to wind-driven precipitation including snow. These conditions may be found in some entrances of buildings, some garages, in sheds, shacks, lofts, telephone booths, buildings in factories and industrial process plants, unattended equipment stations, unattended buildings for telecommunications purposes, ordinary storage rooms for frost-resistant products, farm buildings etc.

5.4 Chemical environment classification

Table 5 shows the derivation of the boundaries used in Table 1.

Table 5 – Derivation of boundaries for chemical criteria in Table 1

Chemical	C_1	C_2	C_3
Liquid pollution ~~(see Note)~~[a] Contaminants	Concentration × 10^{-6}	Concentration × 10^{-6}	Concentration × 10^{-6}
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3
	IEC 60721-1		
Oil (dry-air concentration)	0	< 0,005	< 0,5
Sodium stearate (soap)	None	> 5 × 10^4 aqueous non-gelling	> 5 × 10^4 aqueous gelling
Detergent	None	ffs	ffs
Conductive materials	None	Temporary	Present
Gaseous pollution ~~(see Note)~~[a] Contaminants	Mean/Peak (Concentration × 10^{-6})	Mean/Peak (Concentration × 10^{-6})	Mean/Peak (Concentration × 10^{-6})
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C1, 3C2 and 3C4. NOTE For comparison, the values in IEC 60721-3-3~~, A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 1,539.		

Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 10
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3, with the exception of Class 3 (max < 15). They are identical to ~~the environmental descriptions~~ those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C1 and 3C2 and within the same region for the environmental description 3C4 (mean < 4,5, max < 14). NOTE For comparison, the values in IEC 60721-3-3~~, A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 2,927.		
Sulphur trioxide (ffs)	< 0,01/< 0,03	< 0,1 / < 0,3	< 5 / < 15
	There are no limits in IEC 60654-4:1987 or IEC 60721-3-3.		
Chlorine wet (> 50 % humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. There are no limits in IEC 60721-3-3.		
Chlorine dry (< 50 % humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C1, 3C2 and 3C4. NOTE For comparison, the values in IEC 60721-3-3~~, A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 3,124.		
Hydrogen chloride	– / < 0,06	< 0,06 / < 0,3	< 0,6 / 3,0
	There are no limits in IEC 60654-4:1987. The limits are taken from IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C1, 3C2 and 3C4. NOTE For comparison, the values in IEC 60721-3-3~~, A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 1,639.		
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C1, 3C2 and 3C4. NOTE For comparison, the values in IEC 60721-3-3~~, A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 0,901.		
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C2, 3C3 and 3C4. NOTE For comparison, the values in IEC 60721-3-3 ~~A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 0,771.		
Oxides of nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	< 5 / < 10
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3 ~~A.1~~:1994 for the environmental descriptions 3C1, 3C2 and 3C4. NOTE For comparison, the values in IEC 60721-3-3 ~~A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 1,350 (averaged on NO, NO_2 and NO_3.		
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1
	The limits are taken from IEC 60654-4:1987 for the environmental descriptions Class 1, 2 and 3. They are within the same region as those in IEC 60721-3-3~~, A.1~~:1994 for the environmental descriptions 3C2, 3C3 and 3C4. NOTE For comparison, the values in IEC 60721-3-3 ~~A.1~~:1994 have been converted from mg.cm^{-3} using the STP density = 2,144.		
~~NOTE~~ [a] A single dimensional characteristic, i.e. concentration × 10^{-6}, was chosen to unify limits from different standards.			

From IEC 60654-4:1987:

Class 1: Environments sufficiently well controlled so that corrosion is not a factor in determining corrosion.

Class 2: Environments where the effects of corrosion are measurable and may be a factor in determining equipment reliability.

Class 3: Environments where there is a high probability that corrosive attack will occur.

From IEC 60721-3-3:

3C1R applies to locations with stringently monitored and controlled atmosphere (clean room category).

In addition to the conditions covered by 3C1L, 3C1R applies to locations where the atmosphere is continuously controlled.

In addition to the conditions covered by 3C1R, 3C1 applies to locations in rural and some urban areas with low industrial activities and moderate traffic. Contamination may be increased in urban areas in winter due to heating methods. Salt mist may be present in sheltered locations of coastal areas.

In addition to the conditions covered by 3C1, 3C2 applies to locations with normal levels of contaminants experienced in urban areas with scattered industrial activities or heavy traffic.

In addition to the conditions covered by 3C2, 3C3 applies to locations in the immediate neighbourhood of industrial sources with chemical emissions.

In addition to the conditions covered by 3C3, 3C4 applies to locations within industrial process plants. Emissions of chemical pollutants in high concentrations may occur.

5.5 Electromagnetic environment classification

Table 6 shows the derivation of the boundaries used in Table 1.

Table 6 – Derivation of boundaries for electromagnetic criteria in Table 1

Electromagnetic	E_1	E_2	E_3
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 µC)	8 kV	8 kV	8 kV
	IEC 61000-6-1~~/IEC 61326~~ and IEC 61000-6-2		
Radiated RF – AM	3 V/m at (80 ~~MHz~~ to 1 000) MHz 3 V/m at (1 400 ~~MHz~~ to 2 000) MHz 1 V/m at (2 000 ~~MHz~~ to 2 700) MHz	3 V/m at (80 to 1 000) MHz ~~- 1 000 MHz~~ 3 V/m at (1 400 ~~MHz~~ to 2 000) MHz 1 V/m at (2 000 ~~MHz~~ to 2 700) MHz	10 V/m at (80 ~~MHz~~ to 1 000) MHz 3 V/m at (1 400 ~~MHz~~ to 2 000) MHz 1 V/m at (2 000 ~~MHz~~ to 2 700) MHz
	~~IEC 61000-2-5~~ IEC 61000-6-1		IEC 61000-6-2
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
	IEC 61000-6-1 ~~/IEC 61326~~		IEC 61000-6-2 ~~/IEC 61326~~
EFT/B (comms)	500 V	~~1 000~~ 500 V	1 000 V
	IEC 61000-6-1 ~~IEC 61000-2-5/IEC 61131-2~~		~~IEC 61326:2001, Annex A Table A.1~~ IEC 61000-6-2
Surge (transient ground potential difference) – signal, line to earth	500 V	1 000 V	1 000 V
	IEC 61000-6-1	IEC 61000-6-2	IEC 61000-6-2
Magnetic field (50/60 Hz)	1 Am^{-1}	3 Am^{-1}	30 Am^{-1}
	–	IEC 61000-6-1	IEC 61000-6-2 ~~/IEC 61326~~
Magnetic field (60 Hz to 20 000 Hz)	ffs	ffs	ffs

Bibliography

IEC 60529:1987, *Degrees of protection provided by enclosures (IP Code)*

ISO/IEC 14709-1, *Information technology – Configuration of Customer Premises Cabling (CPC) for applications – Part 1: Integrated Services Digital Network (ISDN) basic access*

ISO/IEC 14709-2, *Information technology – Configuration of Customer Premises Cabling (CPC) for applications – Part 2: Integrated Services Digital Network (ISDN) primary rate*

~~ISO/IEC 14763-1, *Information technology – Implementation and operation of customer premises cabling – Part 1: Administration*~~

ISO/IEC 14763-2, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

ISO/IEC 14763-3, *Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of optical fibre cabling*

~~ISO/IEC 18010, *Information technology – Pathways and spaces for customer premises cabling*~~

ISO/IEC TR 24704, *Information technology – Customer premises cabling for wireless access points*

ISO/IEC TR 24746, *Information technology – Generic cabling for customer premises – Mid-span DTE power insertion*

~~ISO/IEC 24764, *Information technology – Generic cabling for data centres (under consideration)*~~

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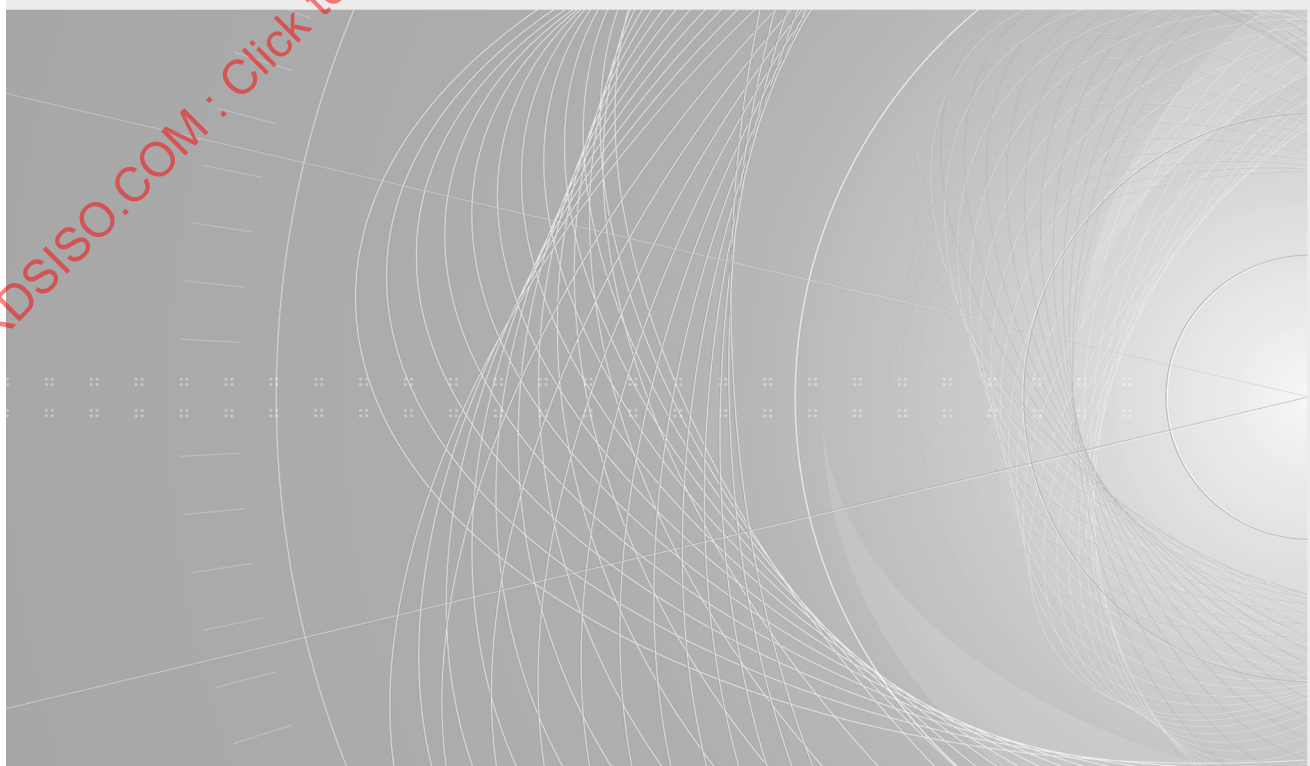
ISO/IEC TR 29106

Edition 1.2 2019-07
CONSOLIDATED VERSION

FINAL VERSION

Information technology –
Generic cabling – Introduction to the MICE environmental classification



CONTENTS

INFORMATION TECHNOLOGY – GENERIC CABLING – INTRODUCTION TO THE MICE ENVIRONMENTAL CLASSIFICATION

FOREWORD

1) ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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This consolidated version of the official IEC Standard and its amendments has been prepared for user convenience.

ISO/IEC TR 29106 edition 1.2 contains the first edition (2007-11), its amendment 1 (2012-12) and its amendment 2 (2019-07) [documents JTC1-SC25/2836/DTR and JTC1-SC25/2853/RVDTR].

This Final version does not show where the technical content is modified by amendments 1 and 2. A separate Redline version with all changes highlighted is available in this publication.

The main task of IEC and ISO technical committees is to prepare International Standards. In exceptional circumstances, ISO/IEC JTC 1 or a subcommittee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where, for any other reason, there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when the technical committee has collected data of a different kind from that which is normally published as an International Standard, for example 'state of the art'.

ISO/IEC 29106, which is a Technical Report of type 3, has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

This Technical Report of type 3 has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

INTRODUCTION to Amendment 1

The Amendment has been developed to correct the misalignment of the MICE table with ISO/IEC 24702.

INFORMATION TECHNOLOGY – GENERIC CABLING – INTRODUCTION TO THE MICE ENVIRONMENTAL CLASSIFICATION

1 Scope

This Technical Report acts as an introduction to the concepts used to develop the MICE environmental classification system used in cabling standards developed by ISO/IEC. It also provides detailed explanation of the sources used to define the boundaries of MICE classifications.

2 Reference documents

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC 11801-2, *Information technology – Generic cabling for customer premises – Part 2: Office premises*

ISO/IEC 11801-3, *Information technology – Generic cabling for customer premises – Part 3: Industrial premises*

ISO/IEC 11801-4, *Information technology – Generic cabling for customer premises – Part 4: Single-tenant homes*

ISO/IEC 11801-5, *Information technology – Generic cabling for customer premises – Part 5: Data centres*

ISO/IEC 11801-6, *Information technology – Generic cabling for customer premises – Part 6: Distributed building services*

IEC 60068-2-5:1975, *Environmental testing – Part 2: Tests. Test Sa: Simulated solar radiation at ground level*

IEC 60654-4:1987 *Operating conditions for industrial-process measurement and control equipment. Part 4: Corrosive and erosive influences*

IEC 60721-1, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*

IEC 60721-3-3, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weatherprotected locations*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61131-2, *Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61918, *Industrial communication networks – Installation of communication networks in industrial premises*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions of the applicable parts of ISO/IEC 11801 apply.

3.2 Abbreviations

For the purposes of this document, the abbreviations of the applicable parts of ISO/IEC 11801 apply.

4 Application of environmental classification

4.1 MICE

The term MICE referenced in generic cabling standards produced by ISO/IEC[1] relates to the classification of the environment of the cabling channel.

There are four primary environmental criteria used to classify an environment:

- the M element, defining the mechanical characteristics of the environment;
- the I element, defining the ingress protection characteristics of the environment;
- the C element, defining the climatic and chemical characteristics of the environment;
- the E element, defining the electromagnetic characteristics of the environment.

Each of the four primary environmental criteria are further divided into specific parameters and levels for those parameters. The MICE classification for a given location is therefore defined as $M_aI_bC_cE_d$ where a, b, c and d are the individual sub-classifications (levels) for the M, I, C and E criteria respectively.

The suffixes for the four primary environmental criteria are either 1, 2 or 3. For example, the most benign environment is described as $M_1I_1C_1E_1$ whereas the most harsh environment within the scope of this standard would be defined as $M_3I_3C_3E_3$.

4.2 Channel environment

The applicable MICE classification may vary along the length of the cabling channel. As shown in the industrial premises cabling example of Figure 1, the ingress protection characteristics of the environment in the automation area and at the automation island are different from, and more severe than, those characteristics on the factory floor or in the telecommunications room.

[1] The documents prepared by subcommittee 25 of ISO/IEC joint technical committee 1: Information technology.

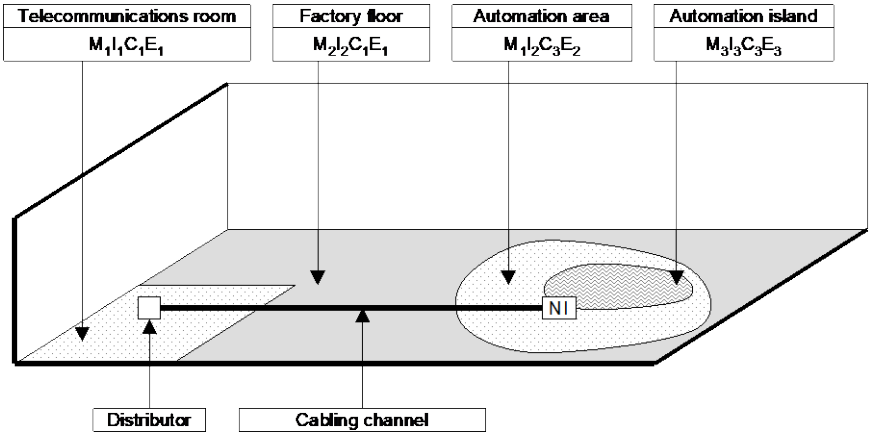

Figure 1 – Example of variation of the environment along an industrial premises cabling channel

The environment to be classified is that local to the cabling. Where no environmental protection is provided to the cabling, the classification of the local environment is also that of the overall environment at that location.

However, where technical or economic restrictions preclude the use of components compatible with the overall environment, mitigation or isolation techniques may be applied to modify one or more of the M, I, C or E environments local to the cabling in order to allow appropriate components to be installed.

The mitigation or isolation techniques typically involve the use of alternative pathways and/or pathway systems as shown in Figure 2.

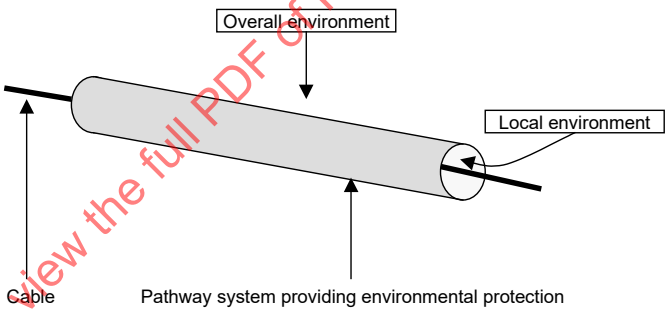

Figure 2 – The local environment

4.3 Component selection

The components used within a channel should be selected to be compatible with the MICE classification of the channel at the point where the components are to be installed.

Table 1, taken from ISO/IEC 11801-1:2017, shows the parameters used to classify the local environment under the M, I, C and E criteria. While the classification of an environment is determined by the most demanding parameter within each criteria group, the selection of components may reflect the specific demands of all the parameters within the group, including those that may be less demanding than the overall classification of the environment.

The MICE classification system is intended to address approximately 80 % of the environments to which cabling may be subjected. There are some environments beyond the boundaries of $M_3I_3C_3E_3$. Such environments are beyond the scope of this Technical Report and require special handling.

Table 1 – Details of environmental classification

Mechanical	**M_1**	**M_2**	**M_3**
Shock/bump[a]			
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}
Tensile strength	b	b	b
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Impact	1 J	10 J	30 J
Bending, flexing and torsion	b	b	b
Ingress	**I_1**	**I_2**	**I_3**
Particulate ingress (max. diameter)	12,5 mm	50 µm	50 µm
Immersion	None	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance	Intermittent liquid jet ≤ 12,5 l/min ≥ 6,3 mm jet > 2,5 m distance and immersion (≤ 1 m for ≤ 30 min)
Climatic and chemical	**C_1**	**C_2**	**C_3**
Ambient temperature	−10 °C to +60 °C	−25 °C to +70 °C	−40 °C to +70 °C
Rate of change of temperature	0,1 °C per minute	1,0 °C per minute	3,0 °C per minute
Humidity	5 % to 85 % (non-condensing)	5 % to 95 % (condensing)	5 % to 95 % (condensing)
Solar radiation	700 Wm^{-2}	1 120 Wm^{-2}	1 120 Wm^{-2}
Liquid pollution[c] Contaminants	Concentration × 10^{-6}	Concentration × 10^{-6}	Concentration × 10^{-6}
Sodium chloride (salt/sea water)	0	< 0,3	< 0,3
Oil (dry-air concentration) (for oil types see [b])	0	< 0,005	< 0,5
Sodium stearate (soap)	None	> 5 × 10^4 aqueous non-gelling	> 5 × 10^4 aqueous gelling
Detergent	None	ffs	ffs
Conductive materials	None	Temporary	Present
Gaseous pollution[c] Contaminants	Mean / Peak (Concentration × 10^{-6})	Mean / Peak (Concentration × 10^{-6})	Mean / Peak (Concentration × 10^{-6})
Hydrogen sulphide	< 0,003 / < 0,01	< 0,05 / < 0,5	< 10 / < 50
Sulphur dioxide	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Sulphur trioxide (ffs)	< 0,01 / < 0,03	< 0,1 / < 0,3	< 5 / < 15
Chlorine wet (> 50 % humidity)	< 0,000 5 / < 0,001	< 0,005 / < 0,03	< 0,05 / < 0,3

Chlorine dry (< 50 % humidity)	< 0,002 / < 0,01	< 0,02 / < 0,1	< 0,2 / < 1,0
Hydrogen chloride	– / < 0,06	< 0,06 / < 0,3	< 0,6 / 3,0
Hydrogen fluoride	< 0,001 / < 0,005	< 0,01 / < 0,05	< 0,1 / < 1,0
Ammonia	< 1 / < 5	< 10 / < 50	< 50 / < 250
Oxides of nitrogen	< 0,05 / < 0,1	< 0,5 / < 1	< 5 / < 10
Ozone	< 0,002 / < 0,005	< 0,025 / < 0,05	< 0,1 / < 1
Electromagnetic	**E_1**	**E_2**	**E_3**
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 µC)	8 kV	8 kV	8 kV
Radiated RF – AM	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	3 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz	10 V/m at (80 to 1 000) MHz 3 V/m at (1 400 to 2 000) MHz 1 V/m at (2 000 to 2 700) MHz
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
EFT/B (comms)	500 V	500 V	1 000 V
Surge (transient ground potential difference) – signal, line to earth	500 V	1 000 V	1 000 V
Magnetic field (50/60 Hz)	1 Am^{-1}	3 Am^{-1}	30 Am^{-1}
Magnetic field (60 Hz to 20 000 Hz)	ffs	ffs	ffs

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

[c] A single dimensional characteristic, i.e. concentration × 10^{-6}, was chosen to unify limits from different standards.

5 MICE system

5.1 General

The MICE concept is provided for the use of designers and planners to allow the specification of components to be purchased and/or protection (mitigation or isolation) required respectively.

Table 1 is not a basis for testing the local environment and neither is it a series of environmental criteria for the testing of components used within those environments. However, the limits describing the MICE classification system are in many cases based upon existing standards. Where such standards are not listed within Tables 2 to 6, no appropriate external references were identified during the development of ISO/IEC 11801-1.

5.2 Mechanical environment classification

Table 2 shows the derivation of the boundaries used in Table 1.

Table 2 – Derivation of boundaries for mechanical criteria in Table 1

Mechanical	M_1	M_2	M_3
Shock/bump[a]			
Peak acceleration	40 ms^{-2}	100 ms^{-2}	250 ms^{-2}
Vibration			
Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Acceleration amplitude (9 Hz to 500 Hz)	5 ms^{-2}	20 ms^{-2}	50 ms^{-2}
Shock/bump/vibration (source material)	IEC 60721-3-3 Class 3M2	< IEC 60721-3-3 Class 3M6	IEC 60721-3-3 Class 3M8
Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Impact	1 J	10 J	30 J
Bending, flexing and torsion	[b]	[b]	[b]

[a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.

[b] This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.

From IEC 60721-3-3:

3M1 applies to locations with insignificant vibration and shock.

In addition to the conditions covered by 3M1, 3M2 applies to locations with vibration of low significance (products mounted on light structures subject to negligible vibration).

In addition to the conditions covered by 3M5, 3M6 applies to locations where the level of vibration is high (e.g. close to heavy machines).

In addition to the conditions covered by 3M7, 3M8 applies to locations where the level of vibration is extremely high (e.g. products mounted on power hammers).