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# TECHNICAL REPORT



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### **ISO/IEC TR 29106**

Edition 1.0 2007-11

# TECHNICAL REPORT – TYPE 3

Information technology-Generic cabling D PREVIEW Introduction to the MICE environmental classification

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#### CONTENTS

FOI	REWC	RD	3			
1	Scop	a				
2	Reference documents					
3	Terms definitions and abbreviations					
Ŭ	3.1 Terms and definitions					
	3.2	Abbreviations	6			
4	Appli	cation of environmental classification	6			
	4.1 MICE					
	4.2	Channel environment	6			
	4.3	Component selection	7			
5	MICE	system	10			
	5.1	General				
	5.2	Mechanical environment				
	5.3	Ingress protection and climatic environment	11			
	5.4	Chemical environment	13			
	5.5	Electromagnetic environment	15			
Bib	iograp	ohy(standards.iteh.ai)	16			
		ICO/IEC/IEB 2010/ 2007				
Fig	ure 1 - Ling ch	- Example of variation of the environment along an industrial premises	7			
	ing ci	249eb829d662/iso-iec-tr-29106-2007	······································			
Figi	ure 2 -	- The local environment	1			
Tab	le 1 –	Details of environmental classification	8			
Tab	le 2 –	Derivation of boundaries for mechanical criteria in Table 1				
Tab	le 3 –	Derivation of boundaries for ingress protection criteria in Table 1	11			
Tab		Derivation of boundaries for climatic criteria in Table 1	11			
Tab		Derivation of boundaries for chamical criteria in Table 1	11 12			
Table 6 Derivation of boundaries for electromegnetic criteria in Table 1						
iab	ie o –	Derivation of boundaries for electromagnetic criteria in Table 1	15			

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

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#### 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 15018, Information technology – Generic cabling for homes

ISO/IEC 24702, Information technology - Generic cabling - Industrial premises

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

#### ISO/IEC TR 29106:2007

IEC 60654-4:1987 Operating conditions for industrial process measurement and control equipment. Part 4: Corrosive and erosive influences 829d662/iso-iec-tr-29106-2007

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.

#### 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.

#### 4 Application of environmental classification

#### 4.1 MICE

The term MICE referenced in generic cabling standards produced by ISO/IEC<sup>1</sup> 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  $M_a I_b C_c E_d$  where a, b, c and d are the individual sub-classifications (levels) for the M, I, C and E criteria respectively  $_{49eb829d662/iso-iec-tr-29106-2007}$ 

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.

<sup>&</sup>lt;sup>1</sup> The documents prepared by subcommittee 25 of ISO/IEC joint technical committee 1: Information technology.





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. DARD PREVIEW

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, 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.

Shock/bump (see a))         40 ms <sup>-2</sup> 100 ms <sup>-2</sup> 250 ms <sup>-2</sup> Vibration         Displacement amplitude (2 Hz to 9 Hz)         1,5 mm         7,0 mm         15,0 mm           Acceleration amplitude (2 Hz to 90 Hz)         5 ms <sup>-2</sup> 20 ms <sup>-2</sup> 50 ms <sup>-2</sup> Tensile force         See b)         See b)         See b)         See b)           Crush         over 25 mm (linear) min.         over 150 mm (linear) min.         over 150 mm (linear) min.           Impact         1 J         10 J         30 J           Bending, flexing and torsion         See b)         See b)         See b)           Imgress         I         I         I           Particulate ingress (dia. max.)         12,5 mm         50 µm         104 mcleared min.           Immersion         Tensite for the set to	Mechanical	<b>M</b> <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>
Peak acceleration40 ms²100 ms²250 ms²VibrationImage: constraint of the second	Shock/bump (see a))			
VibrationImage: constraint amplitude (2 Hz to 9 Hz)1.5 mm7.0 mm15.0 mmAcceleration amplitude (9 Hz to 500 Hz)5 ms²20 ms²50 ms²50 ms²Tensile forceSee b)See b)See b)2 200 NCrushover 25 mm (linear) min.1 100 N over 150 mm (linear) min.2 200 NImpact1 J10 J30 JBending, flexing and torsionSee b)See b)See b)IngressI,IzIsParticulate ingress (dia. max.)12.5 mm50 µm110 mermittent liquid jet s12.5 l/min s2.5 mm jet	Peak acceleration	40 ms <sup>-2</sup>	100 ms <sup>-2</sup>	250 ms <sup>-2</sup>
Displacement amplitude (2 Hz to 9 Hz)1.5 mm7.0 mm15.0 mmAcceleration amplitude (9 Hz to 500 Hz)5 ms²20 ms²50 ms²Tensile forceSee b)See b)See b)Crush $45$ N over 25 mm (linear) min.100 N 	Vibration			
$\begin{tabular}{ c c c c c } \hline Acceleration amplitude (9 Hz to 500 Hz) $$ 5 m s^2$ 20 m s^2$ 50 m s^2$ $$ 50 m s^2$ $$ 10 m s^2$ $$ 50 m s^2$ $$ 10 m s^2$ $$ 1$	Displacement amplitude (2 Hz to 9 Hz)	1,5 mm	7,0 mm	15,0 mm
Tensile force         See b)         See b)         See b) $Crush$ $45 N$ over 25 mm (linear) min. over 150 mm (linear) min. over 150 mm (linear) min. over 150 mm (linear) min. $2200 N$ over 150 mm (linear) min. $30 J$ Impact         1 J         10 J $30 J$ Bending, flexing and torsion         See b)         See b)         See b)           Ingress $h$ $l_2$ $h$ Particulate ingress (dia. max.)         12.5 mm         50 µm $50 µm$ Immersion         None $see b$ $see b$ $see b$ Immersion         Standback $h$ $bc$ $see b$ Climatic and chemical         (standback $see b$ $see b$ $see b$ Ambient temperature         0.1 [Sper_minuteg_106 $see b$ $see b^{3}$ $see b^{3}$ Humidity         htps://standa $steh as 5 w b & 5 m dat set b$ $see b^{3}$ $see b^{3}$ Solar radiation         700 Wm <sup>2</sup> 1 120 Wm <sup>2</sup> 1 120 Wm <sup>2</sup> $see 5 \times 10^{4}$ aqueous gelling           Iquid pollution (see c))         Concentration $\times 10^{4}$ Concentration $\times 10^{4}$ $co.5 \times 10^{4}$ aqueous gelling $se 5$	Acceleration amplitude (9 Hz to 500 Hz)	5 ms <sup>-2</sup>	20 ms <sup>-2</sup>	50 ms <sup>-2</sup>
	Tensile force	See b)	See b)	See b)
$\begin{array}{                                    $	Crush	45 N over 25 mm (linear) min.	1 100 N over 150 mm (linear) min.	2 200 N over 150 mm (linear) min.
Bending, flexing and torsionSee b)See b)See b)IngressI,IzJParticulate ingress (dia. max.)12,5 mm $50  \mu m$ $50  \mu m$ Immersion12,5 mm $50  \mu m$ $50  \mu m$ $50  \mu m$ ImmersionNoneIntermittent liquid jet $< 12,5  l/min$ $> 2,5 m distanceand immersionIntermittent liquid jet< 12,5  l/min> 2,5 m distanceand immersionStatute< 3,0  m jet> 2,5 m distanceand immersionClimatic and chemicalCharter of the for C-10  ^{\circ} Co te 40 ^{\circ} Co to 470 ^{\circ} Co 440 ^{\circ} Co to 470 ^{\circ}C24 (non-sondensing)Co co 40 ^{\circ} Co to 470 ^{\circ}CRate of change of temperature0.1 (Stept minuteo) 106 prot 1.0 ^{\circ} Co per minute3.0 ^{\circ}C per minuteHumidityhttps://standa.dis.iteh.afs.%iteb.85.%iteb.85.%iteb.85.%iteb.95.%-9617-24(non-sondensing)5.% to 95.%(condensing)Solar radiation700 Wm²1.120 Wm²1.120 Wm²Liquid pollution (see c))ContaminantsConcentration × 10.6Concentration × 10.6Oil (dry-air concentration)(for oil types see b))0<0.3$	Impact	1 J	10 J	30 J
IngressInInInInParticulate ingress (dia. max.)12.5 mm50 µm50 µmParticulate ingress (dia. max.)12.5 mm50 µm1000000000000000000000000000000000000	Bending, flexing and torsion	See b)	See b)	See b)
Particulate ingress (dia. max.)12,5 mm50 µm50 µmImmersionNoneIntermittent liquid jet $\leq 12,5$ l/min $\geq 6,3$ mm jet $\geq 2,5$ m distance $2,5$ m distance $3,0$ °C per minuteHumidityIntermittentinguite $2,5$ m distance $2,0007$ 1.0 °C per minute $3,0$ °C per minute $3,0$ °C per minuteHumidityIntervite $10,000 \text{ Mm}^2$ 1 120 Wm^21 120 Wm^2Liquid pollution (see c)) (for oil types see bi)Concentration $\times 10^6$ Concentration $\times 10^6$ Oil (dry-air concentration) (for oil types see bi)NoneFersona	Ingress	I <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>
$\begin{tabular}{ c c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Particulate ingress (dia. max.)	12,5 mm	50 µm	50 µm
$\begin{array}{ c c c c } \hline Climatic and chemical \\ \hline C$	Immersion iTeh	None <b>STANDARD</b>	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 minutes)
Ambient temperature-10 °C to +60 °C-25 °C to +70 °C-40 °C to +70 °CRate of change of temperature0.1 °C per (inpute_0106-007 1.0 °C per minute3.0 °C per minuteHumidityhttps://standads.iteh.ai5.%ibo.86.%lards/sist08a65bc5 %/foi 95.%-96f7- 24(non-condensing)_C-tr- 0106-2((condensing))5 % to 95 % (condensing)Solar radiation700 Wm²1 120 Wm²1 120 Wm²Liquid pollution (see c)) ContaminantsConcentration × 10° 6Concentration × 10° 6Sodium chloride (salt/sea water)0<0.3	Climatic and chemical	(standards it	$\mathbf{e}\mathbf{h}$ ai) $\mathbf{c}_2$	<b>c</b> <sub>3</sub>
Rate of change of temperature $0.1 \ Cper minute 9106 \ 2007 \ 1.0 \ Cper minute3.0 \ Cper minuteHumidityhttps://standads.itch.ais.%ito.as.%lards/sist08a65bc5 %/toi.9i.%-96f7-24(non-condensing)5 \ \% \ to 95 \ \% \ (condensing)Solar radiation700 Wm-21 120 Wm-21 120 Wm-2Liquid pollution (see c))ContaminantsConcentration \times 10^{-6}Concentration \times 10^{-6}Sodium chloride (salt/sea water)0<0,3$	Ambient temperature	-10 °C to +60 °C	-25 °C to +70 °C	-40 °C to +70 °C
Humidityhttps://standa ds.itch.ai5.% to 265.% Index/sist 08865bc5.% To 95 % (condensing)Solar radiation700 Wm²1 120 Wm²1 120 Wm²Liquid pollution (see c)) ContaminantsConcentration $\times 10^{-6}$ Concentration $\times 10^{-6}$ Concentration $\times 10^{-6}$ Sodium chloride (salt/sea water)0<0,3	Rate of change of temperature	0,1 <u>Cperminute9106</u> :	2007 1,0 °C per minute	3,0 °C per minute
$ \frac{Solar radiation}{Solar radiation} = \frac{700 \text{ Wm}^{-2}}{Concentration \times 10^{-6}} + \frac{1120 \text{ Wm}^{-2}}{Concentration \times 10^{-6}} + \frac{Concentration \times 10^{-6}}{Concentration \times 10^{-6}} + Concentration \times 10^{$	Humidity https://standar	ds.iteh.ai5:%alog85a%lards/sist 24(non-condensing)c-tr-2	08a65be5-%7to1951%-96f7- 9106-20(condensing)	5 % to 95 % (condensing)
$ \begin{array}{c c} \mbox{Liquid pollution (see c))} & \mbox{Concentration \times 10^{-6}} & \mbox{Concentration } \times 10^{-6} & \mbox{Concentration } & \mbox{O} & \mbox{Concentration} & \mbox{O} & \mbox{Concentration} & \mbox{O} & \mbox{Concentration} & \mbox{O} & \mbox{Concentration} & \mbo$	Solar radiation	700 Wm <sup>-2</sup>	1 120 Wm <sup>-2</sup>	1 120 Wm <sup>-2</sup>
$\begin{array}{c c c c c c c c c } Sodium chloride (salt/sea water) & 0 & <0,3 & <0,3 \\ \hline Oil (dry-air concentration) & 0 & <0,005 & <0,5 \\ \hline (for oil types see b)) & 0 & <0,005 & <0,5 \\ \hline Sodium stearate (soap) & None & >5 \times 10^4 aqueous non- \\ gelling & >5 \times 10^4 aqueous gelling \\ \hline Detergent & None & ffs & ffs \\ \hline Conductive materials & None & Temporary & Present \\ \hline Gaseous pollution (see b)) & Mean/Peak & Mean/Peak & Mean/Peak & Mean/Peak & (Concentration \times 10^{-6}) \\ \hline Hydrogen sulphide & <0,003/<0,01 & <0,05/<0,5 & <10/<50 \\ \hline Sulphur dioxide & <0,01/<0,03 & <0,1/<0,3 & <5/<15 \\ \hline \end{array}$	Liquid pollution (see c)) Contaminants	Concentration $\times$ 10 <sup>-6</sup>	Concentration $\times$ 10 <sup>-6</sup>	Concentration $\times$ 10 <sup>-6</sup>
$\begin{array}{c c c c c c c c } \mbox{Oil (dry-air concentration)}\\ (for oil types see b)) \end{array} & 0 & <0,005 & <0,5 \\ \end{tabular} \label{eq:concentration} \\ \end{tabular} \label{eq:concentration} eq:c$	Sodium chloride (salt/sea water)	0	<0,3	<0,3
Sodium stearate (soap)None>5 $\times$ 10 <sup>4</sup> aqueous non- gelling>5 $\times$ 10 <sup>4</sup> aqueous gellingDetergentNoneffsffsConductive materialsNoneTemporaryPresentGaseous pollution (see b))Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )Hydrogen sulphide<0,003/<0,01	Oil (dry-air concentration) (for oil types see b))	0	<0,005	<0,5
DetergentNoneffsffsConductive materialsNoneTemporaryPresentGaseous pollution (see b))Mean/Peak (Concentration × 10-6)Mean/Peak (Concentration × 10-6)Mean/Peak (Concentration × 10-6)Hydrogen sulphide<0,003/<0,01	Sodium stearate (soap)	None	$>5 \times 10^4$ aqueous non-gelling	$>5 \times 10^4$ aqueous gelling
Conductive materialsNoneTemporaryPresentGaseous pollution (see b))Mean/Peak (Concentration × 10 <sup>-6</sup> )Mean/Peak (Concentration × 10 <sup>-6</sup> )Mean/Peak (Concentration × 10 <sup>-6</sup> )Hydrogen sulphide<0,003<<0,01	Detergent	None	ffs	ffs
Gaseous pollution (see b))Mean/Peak (Concentration × 10 <sup>-6</sup> )Mean/Peak (Concentration × 10 <sup>-6</sup> )Mean/Peak (Concentration × 10 <sup>-6</sup> )Hydrogen sulphide<0,003/<0,01	Conductive materials	None	Temporary	Present
Hydrogen sulphide         <0,003/<0,01         <0,05/<0,5         <10/<50           Sulphur dioxide         <0,01/<0,03	Gaseous pollution (see b)) Contaminants	Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )	Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )	Mean/Peak (Concentration $\times$ 10 <sup>-6</sup> )
Sulphur dioxide         <0,01/<0,03         <0,1/<0,3         <5/<15           Sulphur trioxide (ffs)         <0,01/<0,03	Hydrogen sulphide	<0,003/<0,01	<0,05/<0,5	<10/<50
Sulphur trioxide (ffs)         <0,01/<0,03         <0,1/<0,3         <5/<15	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

#### Table 1 – Details of environmental classification

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  $\times$  10<sup>-6</sup>, was chosen to unify limits from different standards.

Climatic and chemical (continued)	<b>c</b> <sub>1</sub>	<b>c</b> <sub>2</sub>	C <sub>3</sub>		
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 <sub>1</sub>	E <sub>2</sub>	E <sub>3</sub>		
Electrostatic discharge – Contact (0,667 µC)	4 kV	4 kV	4 kV		
Electrostatic discharge – Air (0,132 μC)	8 kV	8 kV	8 kV		
	3 V/m at (80 MHz to 1 000 MHz)	3 V/m at (80 MHz to 1 000 MHz)	10 V/m at (80 MHz to 1 000 MHz)		
Radiated RF – AM	3 V/m at ((1 400 MHzto 2 000 MHz)	3 V/m at ((1 400 MHz to 2 000 MHz)	3 V/m at ((1 400 MHz to 2 000 MHz)		
	1 V/m at (2 000 MHz to 2 700 MHz)	1 V/m at (2 000 MHz to 2 700 MHz)	1 V/m at (2 000 MHz to 2 700 MHz)		
Conducted RF <b>iTeh</b>	3V 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)	(standards.it	<b>eh.ai)</b> 000 v	1 000 V		
Surge (transient ground potential difference) – signal, line to earth	500 V ISO/IEC TR 29106:	1 000 V 2007	1 000 V		
Magnetic field (50/60 Hz)tps://standar	ds.iteh.ai/catalAgystandards/sist	08a65be2-c37Am4a6a-96f7-	30 Am⁻¹		
Magnetic field (60 Hz to 20 000 Hz)	249eb829d662/iso-iec-tr-2 ffs	9106-2007 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  $\times$  10<sup>-6</sup>, was chosen to unify limits from different standards.