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# TECHNICAL REPORT

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

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

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

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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 Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.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.

# 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 – 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.

## 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[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.

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

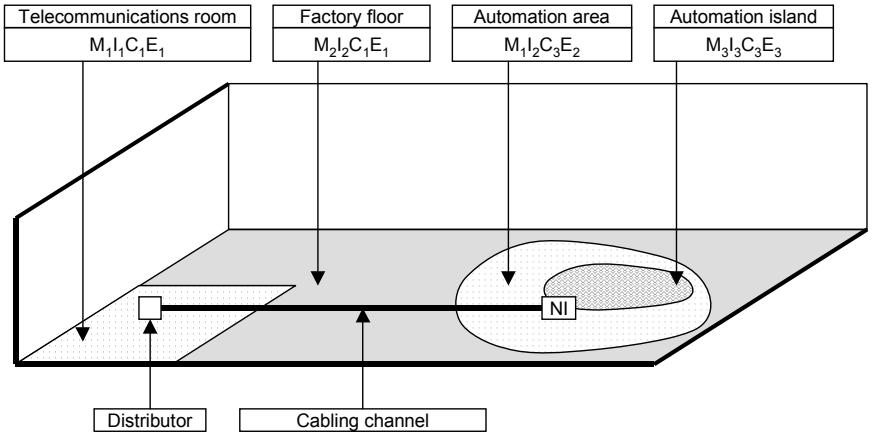


**Figure 1 – Example of variation of the environment along an industrial premises cabling channel**

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.

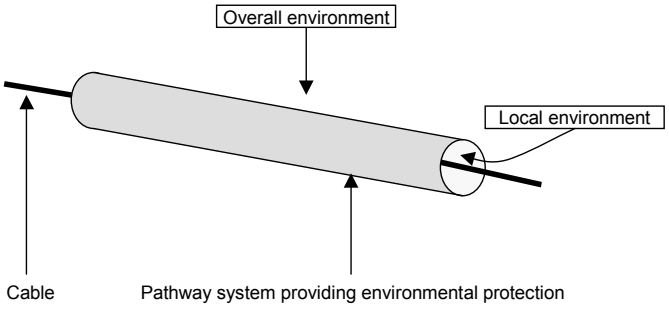


**Figure 2 – The local environment**

### 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 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.

**Table 1 – Details of environmental classification**

| **Mechanical** | **$M_1$** | **$M_2$** | **$M_3$** |
|---|---|---|---|
| Shock/bump (see 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 | See b) | See b) | See 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 | See b) | See b) | See b) |
| **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 minutes) |
| **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 (see 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)) 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 |

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.

| **Climatic and chemical (continued)** | **$C_1$** | **$C_2$** | **$C_3$** |
|---|---|---|---|
| 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 MHz to 1 000 MHz)<br>3 V/m at ((1 400 MHzto 2 000 MHz)<br>1 V/m at (2 000 MHz to 2 700 MHz) | 3 V/m at (80 MHz to 1 000 MHz)<br>3 V/m at ((1 400 MHz to 2 000 MHz)<br>1 V/m at (2 000 MHz to 2 700 MHz) | 10 V/m at (80 MHz to 1 000 MHz)<br>3 V/m at ((1 400 MHz to 2 000 MHz)<br>1 V/m at (2 000 MHz 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 | 1 000 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 $\times 10^{-6}$, 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.

## 5.2 Mechanical environment

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 over 150 mm (linear) min. |
| Impact | 1 J | 10 J | 30 J |
| [a] Bump: the repetitive nature of the shock experienced by the channel shall be taken into account. | | | |

**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

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<br>≤12,5 l/min<br>≥6,3 mm jet<br>>2,5 m distance | Intermittent liquid jet<br>≤12,5 l/min<br>≥6,3 mm jet<br>>2,5 m distance<br>and<br>immersion<br>(≤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<br>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 %<br>(non-condensing) | 5 % to 95 %<br>(condensing) | 5 % to 95 %<br>(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<br>Class 3K3 – 3K6 | IEC 60721-3-3 Class 3K7.<br>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

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)<br>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 × 104 aqueous non-gelling | >5 × 104 aqueous gelling |
| Detergent | None | ffs | ffs |
| Conductive materials | None | Temporary | Present |
| Gaseous pollution (see Note)<br>Contaminants | Mean/Peak<br>(Concentration × $10^{-6}$) | Mean/Peak<br>(Concentration × $10^{-6}$) | Mean/Peak<br>(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.<br>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 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).<br>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.<br>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.<br>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. | | |
| NOTE A single dimensional characteristic, i.e. Concentration × $10^{-6}$, was chosen to unify limits from different standards. | | | |

| Chemical | $C_1$ | $C_2$ | $C_3$ |
|---|---|---|---|
| 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.<br>NOTE For comparison the values in IEC 60721-3-3, A.1:1994 have been converted from $mg \cdot cm^{-3}$ 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.<br>NOTE For comparison the values in IEC 60721-3-3 A.1:1994 have been converted from $mg \cdot cm^{-3}$ 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.<br>NOTE For comparison the values in IEC 60721-3-3 A.1:1994 have been converted from $mg \cdot cm^{-3}$ using the STP density = 1.350 (averaged on No, NO2 and NO3. | | |
| 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.<br>NOTE For comparison the values in IEC 60721-3-3 A.1:1994 have been converted from $mg \cdot cm^{-3}$ using the STP density = 2.144. | | |
| NOTE A single dimensional characteristic, i.e. Concentration $\times 10^{-6}$, 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

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 | | |
| Radiated RF - AM | 3 V/m at 80 MHz to 1 000 MHz<br>3 V/m at 1 400 MHz to 2 000 MHz<br>1 V/m at 2 000 MHz to 2 700 MHz | 3 V/m at 80 MHz -1 000 MHz<br>3 V/m at 1 400 MHz to 2 000 MHz<br>1 V/m at 2 000 MHz to 2 700 MHz | 10 V/m at 80 MHz to 1 000 MHz<br>3 V/m at 1 400 MHz to 2 000 MHz<br>1 V/m at 2 000 MHz to 2 700 MHz |
| | IEC 61000-2-5 | | |
| 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 V | 1 000 V |
| | IEC 61000-6-1 | IEC 61000-2-5/IEC 61131-2 | IEC 61326:2001, Annex A Table A.1 |
| Surge (transient ground potential difference) - signal, line to earth | 500 V | 1 000 V | 1 000 V |
| | 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 |

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