

Environmental Conditions for Industrial Areas

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Introduction

There are two sets of environmental conditions with respect to Industrial spaces. One) Minimum Legal test limits and 2) Expected conditions based on the MICE concept (Mechanical, Ingress, Climatic/Chemical and Electromagnetic. In some cases these environments have the same values.

The MICE concept was developed in coordination with ISO/IEC/JTC1/SC25C/WG3 and ANSI/TIA/TR42. The MICE concept provides for 3 classifications with increasing severity ranging from commercial office environments to harsh industrial environments. The source for the values contained in the MICE Technical report (ISO/IEC/TR29106) were extracted from three IEC environmental standards IEC60654-n, IEC60721 and IEC61000-n. The latter has a direct link to the Minimum Legal Test Limits for Industrial equipment.

Minimum Legal Limits - Mechanical

Vibration			
Displacement amplitude	15 mm, 2 Hz to 9 Hz	-	IEC60068-2-6, Test Fc
Acceleration amplitude	50 ms ⁻² , 9 Hz to 500 Hz	50 ms ⁻² , 10 Hz to 500 Hz	IEC60068-2-6, Test Fc
Shock and bump			
Peak acceleration	250 ms ⁻²	300 ms ⁻²	IEC 60068-2-27, Test Ea

Ingress (not a legal requirement)

NEMA and International Protection Class				
IP	IP20	IP65	IP65/67	

MLL Cont. - Climatic

Temperature and Humidity			
Operational	-25...85 °C	0...50 °C	IEC60068-2-1/2, Test Ad/Bd IEC60068-2-14, Test Nb
Non Operational	-25...85 °C	-40...85 °C	IEC60068-2-1/2, Test Ab/Bb IEC60068-2-14, Test Na
Humidity	5 to 95 % noncondensing	5 to 95 % noncondensing	IEC 60068-2-30, Test Db

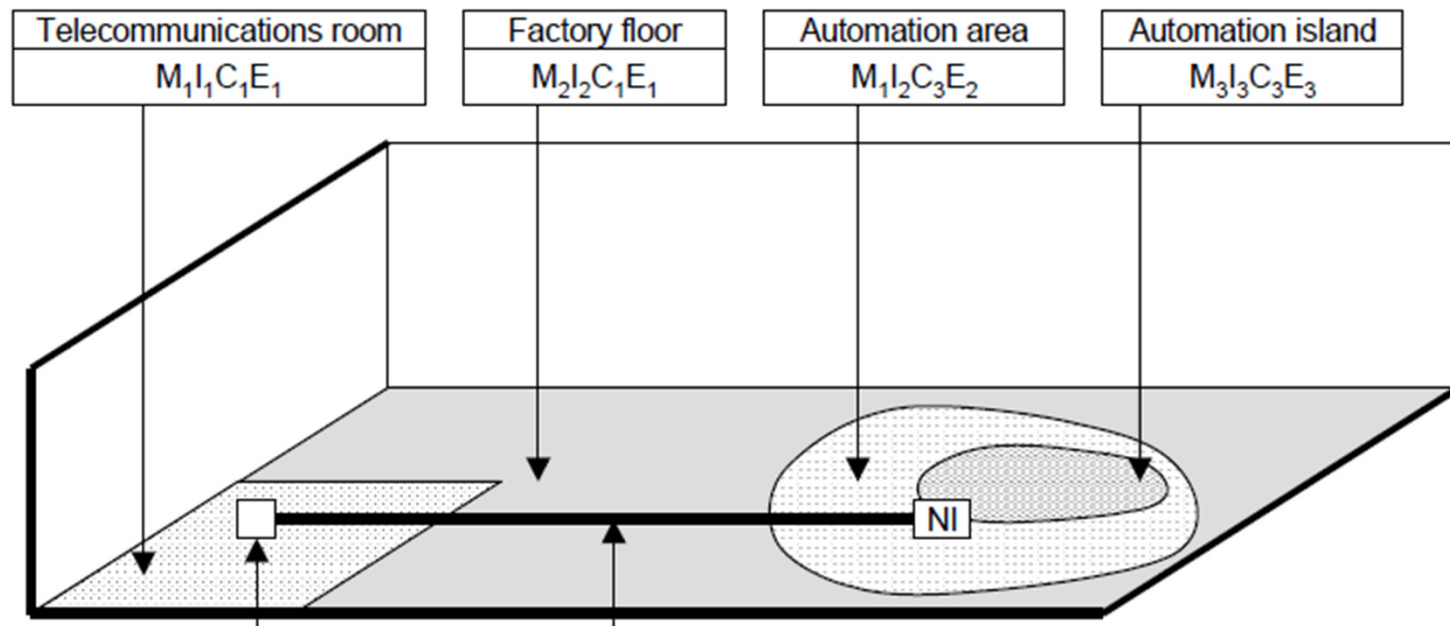
MLL Cont. - Electromagnetic

Emissions			
Radiated (enclosure)		Class A, , 30 MHz to 6 GHz	CISPR11/22
Conducted (telecomm)		Class A, 150 kHz to 30 MHz	CISPR22
Immunity			
ESD Contact discharge	4kV HBM	4kV HBM	IEC61000-4-2
ESD Air discharge	8kV HBM	8kV HBM	IEC61000-4-2

MLL Cont. - Electromagnetic

Immunity			
Radiated RF	10Vm^{-1} (80...1000 MHz, 80% AM @ 1kHz) 3Vm^{-1} (1.4...2.0 GHz, 80% AM @ 1kHz) 1Vm^{-1} (2.0...2.7 GHz, 80% AM @ 1kHz)	10Vm^{-1} (80...1000 MHz, 80% AM @ 1kHz) 3Vm^{-1} (1.4...2.0 GHz, 80% AM @ 1kHz) 1Vm^{-1} (2.0...2.7 GHz, 80% AM @ 1kHz)	IEC61000-4-3
Conducted RF	10V_{RMS} (150 KHz...80 MHz, 80% AM @ 1kHz)	10V_{RMS} (150 KHz...80 MHz, 80% AM @ 1kHz)	IEC61000-4-6
EFT/B	1KV	1kV on signal ports 2kV on power ports	IEC61000-4-4
Surge	2KV	1kV CM on signal ports 2kV CM/1kV DM on power ports	IEC61000-4-5
Magnetic Fields	30Am^{-1}	30Am^{-1}	IEC61000-4-8

Environmental Areas on the Factory Floor



Commercial and Industrial Environmental Classification - Mechanical

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)

Commercial and Industrial Environmental Classification - Ingress

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)

Commercial and Industrial Environmental Classification - Climatic (partial)

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

Due to enclosure heat rise, components may reach 105 deg C.

Commercial and Industrial Environmental Classification - Electromagnetic

Electromagnetic	E₁	E₂	E₃
Electrostatic discharge – Contact (0,667 μ C)	4 kV	4 kV	4 kV
Electrostatic discharge – Air (0,132 μ C)	8 kV	8 kV	8 kV
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 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)	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)

Commercial and Industrial Environmental Classification – Electromagnetic (cont.)

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
<p>a) Bump: the repetitive nature of the shock experienced by the channel shall be taken into account.</p> <p>b) This aspect of environmental classification is installation-specific and should be considered in association with IEC 61918 and the appropriate component specification.</p> <p>c) A single dimensional characteristic, i.e. concentration $\times 10^{-6}$, was chosen to unify limits from different standards.</p>			