TECHNICAL REPORT

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Lifts, escalators and passenger conveyors — Comparison of worldwide standards on electromagnetic interference/electromagnetic compatibility

Ascenseurs, escaliers mécaniques et trottoirs roulants — Comparaison des normes mondiales relatives à l'interférence électromagnétique/la compatibilité électromagnétique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 16764 was prepared by Technical Committee ISO/TC 178, *Lifts, escalators, passenger conveyors*.

0 Introduction

0.1 Background

International standardizing bodies such as IEC, ISO, CISPR, CENELEC, have been involved in drawing up common normative and technical documents to bring international markets closer together.

At the 1996 plenary meeting of ISO/TC 178, it was decided to carry out a comparison between various national and international electrical requirements applicable to lifts (elevators) and escalators. The first objective was to identify and compare the major EMC requirements applicable in the countries of the Working Group members (Resolution 1996/134).

The content of this Technical Report is based on the information provided by ISO/TC 178/WG 8 members.

0.2 Understanding electromagnetic interference/electromagnetic compatibility (EMI/EMC)

An electromagnetic disturbance (noise that is not sinusoidal or unwanted signal) is any electromagnetic phenomenon which may degrade the performance of a device, equipment or system. Electromagnetic interference (EMI) is the degradation in the performance of a device, equipment or system caused by an electromagnetic disturbance. The cause of EMI is unplanned coupling between a source and a receptor by means of a transmission path. Transmission paths may be conducted or radiated. See, for example, Figure 1.

The ability of the device, equipment or system to function satisfactorily in an electromagnetic environment, without introducing intolerable disturbances to that environment is called electromagnetic compatibility (EMC).

EMC has three elements:

a) a source of energy

b) a receptor that is disrupted by this energy

c) a coupling path between the source of energy and receptor.

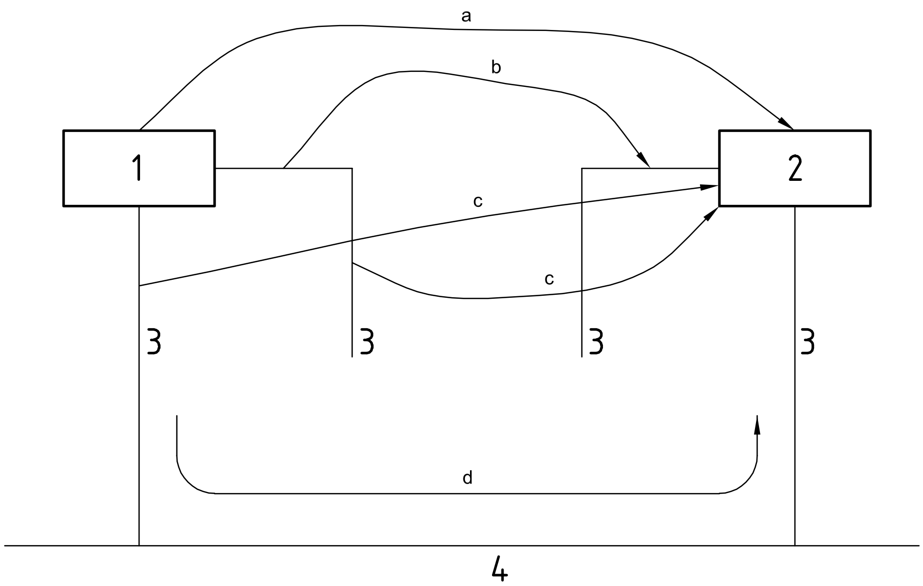
Methods of coupling electromagnetic energy from a source to a receptor fall into one of four categories:

a) conducted (electric current)

b) inductively coupled (magnetic field)

c) capacitively coupled (electric field)

d) radiated (electromagnetic field).



Key

1 source

2 receptor

3 cable

4 power line

[a] Path 1: direct radiation from source to receptor.

[b] Path 2: direct radiation from source, picked up by cables (power, signal and control) connected to the receptor, which reaches the receptor via conduction path.

[c] Path 3: EMI radiated by cables (power, signal or control) of the source.

[d] Path 4: EMI conducted from source to receptor via cables (common power supply, signal/control).

NOTE 1 Source: Engineering EMC-IEEE Press.

NOTE 2 EMI carried by power/signal/control cables that are connected to the source can be coupled to the power/signal/control cables of the receptor, especially when cable harnesses are bundled, even when common power/signal/control cables do not exist.

Figure 1 — Mechanisms of electromagnetic interference

Lifts, escalators and passenger conveyors — Comparison of worldwide standards on electromagnetic interference/electromagnetic compatibility

1 Scope

This Technical Report consists of a comparison of electromagnetic interference/electromagnetic compatibility (EMI/EMC) worldwide standards of interest to the lift industry.

2 Electromagnetic interference/electromagnetic compatibility standards

2.1 Background

With the advent of radio broadcast transmission in the 1920s, the interference from radio noise (i.e. electromagnetic noise) became a concern of engineers in Europe and North America and many technical papers were beginning to be published dealing with electromagnetic interference (EMI). Early studies showed that motor driven appliances, switches, automobile ignitions, electric traction and electrical power lines, among other sources, caused radio interference.

2.2 CISPR/IEC

In 1933 the International Special Committee on Radio Interference (CISPR, Comité International Spécial de Perturbations Radioélectriques) was formed as a result of a joint effort of the International Electrotechnical Commission (IEC) and the International Union of Broadcasting. The first meeting of CISPR was held in 1934 to address limits of EMI and methods of measurement. Following World War II, the United States, Canada and Australia started to participate in CISPR. Subsequently countries from Asia and other parts of the world also started participating in CISPR. The emphasis initially was on getting agreement on measurement procedures and instrumentation for the protection of radio services with particular emphasis on radio broadcasting. The subject of acceptable performance limits was left to a later date. IEC/TC 65 was formed in the early 1960s and was also concerned with EMC requirements. In 1974, the IEC established a new technical committee (IEC/TC 77) to cover EMC subjects not generally dealt with by the CISPR, in particular, immunity characteristics of all kinds of equipment and emission phenomena below 9 kHz, the lower end of the radio frequency spectrum. The organization of these committees in the IEC is shown in Figure 2. In formal structure, the CISPR is a separate organization from the IEC. However it should be noted that the plenary is constituted of representation from various international organizations, as well as by the National Committees of the IEC. In the IEC council, only the National Committees are represented. Also, the publications of the CISPR are issued by the IEC, and the operational procedures are identical in most respects.

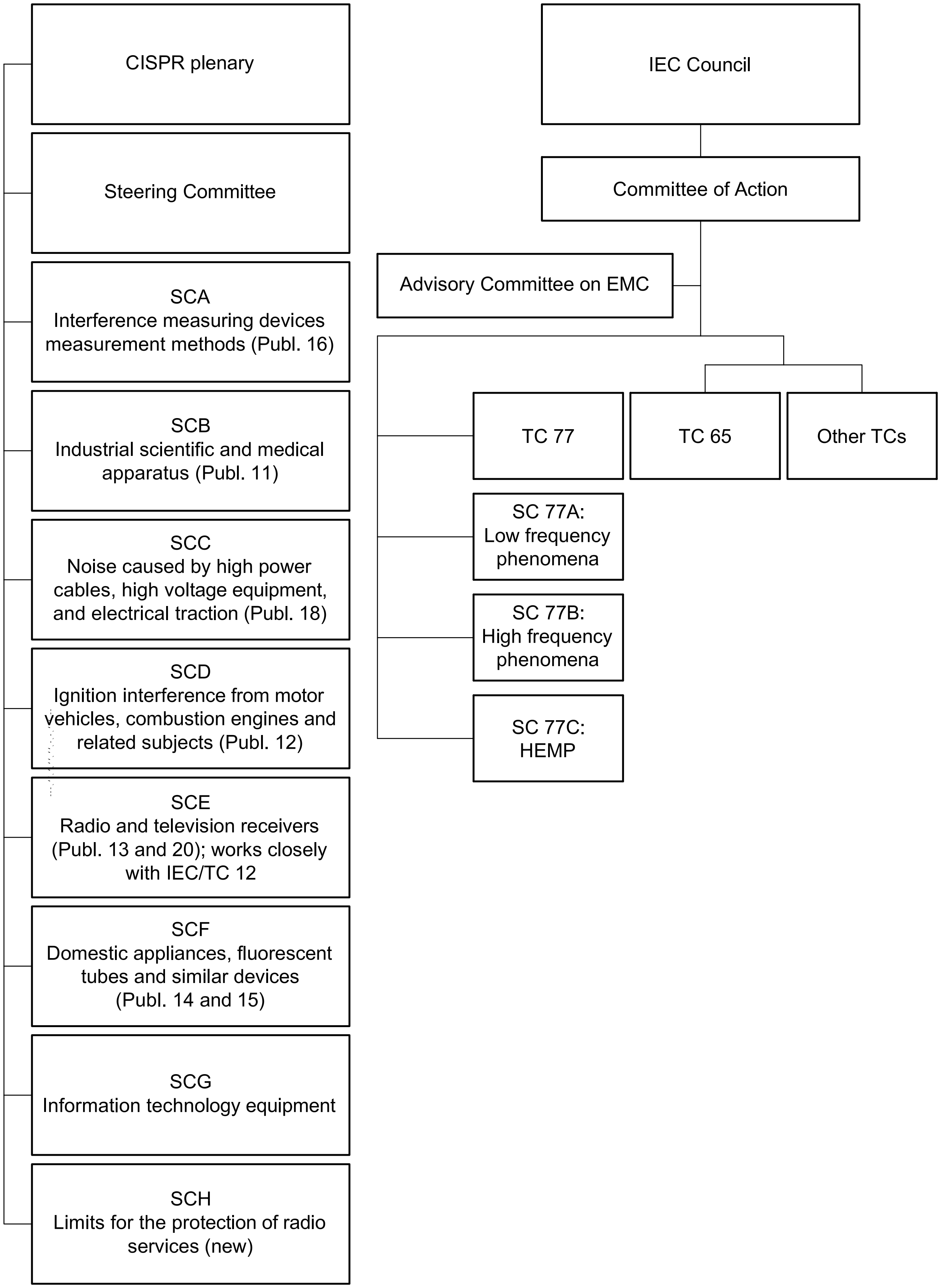


Figure 2 — Organization of CISPR and IEC technical committees responsible for EMI/EMC standards

2.3 National committees/standards

2.3.1 When the CISPR was organized, national regulatory agencies such as the Federal Communications Commission (FCC) in the US, the British Standards Institution (BSI) in the UK, Fernmelde Technisches Zentralamt (FTZ) in Germany, Voluntary Control Council for Interference (VCCI) in Japan and similar institutions in other countries also started promulgating interference control limits applicable in their respective countries.

2.3.2 The China Technical Committee of Standardization of Radio Interference (CTCSRI) was established in 1981 under the leadership of the China State Bureau of Technical and Quality Supervision. One of its tasks is to study the IEC/CISPR EMC/EMI standards and develop China's own EMC/EMI standards. There are eight subcommittees from A to G and S which concern respectively test instrument, ISM equipment, mobile, radio receiver, household appliances and electric tools, office equipment, and radio and non-radio systems. In 1993, GB/T13926 was published which is equivalent to IEC 60801. Currently, there are more than forty EMC/EMI standards published covering limits, test methods and related aspects such as site requirements and personal hazards. There is a concerted effort in China to move towards those of the IEC/CISPR.

2.3.3 In the United States commercial EMC standards activities are coordinated through the efforts of ANSI Accredited Standards Committee C63 for which the Institute of Electrical & Electronic Engineers (IEEE) is the secretariat. Several societies of the IEEE and trade organizations such as EIA, NEMA, SAE and others as well as Accredited Standards Committee C63 have developed standards pertaining to EMC. Except for cases in which commercial standards are referenced in federal (legal) documents, for example C63.4 is called out in FCC requirements, the use of these standards is wholly voluntary in the US. See Figure 3. While there is a concerted effort to move the C63 documents towards those of the IEC/CISPR differences between the IEC/CISPR and the US National standards persist.

Emission requirements in the United States are specified by the Federal Communication Commission (FCC).

The FCC administers civilian use of the frequency spectrum in the USA. Title 47 of the Code of Federal Regulations covers telecommunication and controls the intentional and incidental use of the frequency spectrum. The parts relevant to EMC are contained in Chapter 1: Part 15 — Radio Frequency Devices and Part 18 — Industrial, Scientific and Medical Equipment. FCC Part 15 has extended the measurement range for digital devices or computers up to 5 GHz.

The FCC has participated in the development of CISPR 22, and its requirements are similar to but not identical to those of CISPR 22. The FCC has adopted ANSI C63.4 measurement procedures for testing digital devices and computers. There are two classifications of digital devices:

— Class A: for the use in a commercial, industrial or business environment;

— Class B: for use in a residential environment.

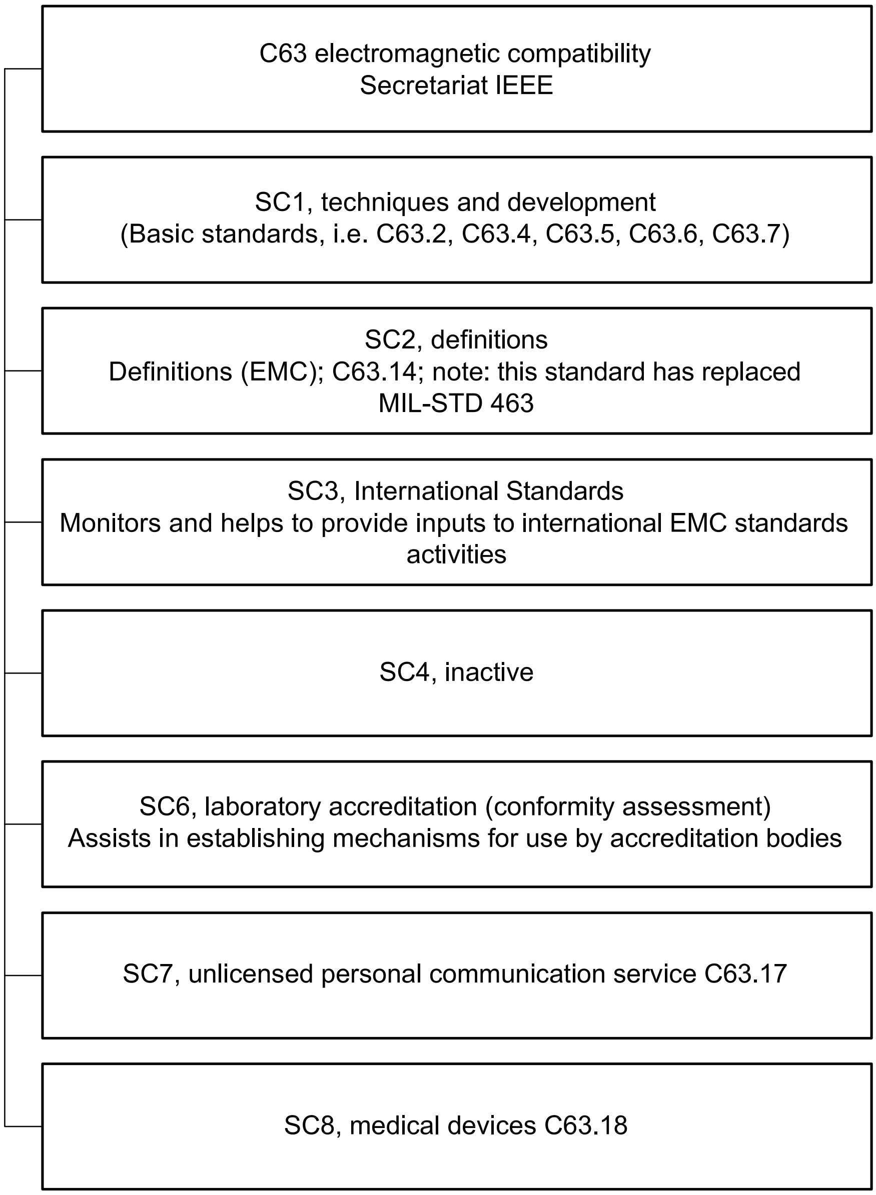


Figure 3 — Structure of American National Standards Committee C63

Harmful interference is defined as any emission, radiation or induction that may endanger the functioning of a radio navigation service or other safety services or which seriously degrades, obstructs or repeatedly interrupts a radio communications service operating in accordance with the regulations.

Although there are no requirements for **susceptibility** the “parties responsible for equipment compliances” are advised to consider susceptibility to interference (e.g. by proximity to high power broadcast stations).

Devices are required to bear the following statement (**label**):

> “This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”

ANSI standards: Although the American national standards are based on broad consensus of the manufacturers and users, they are nevertheless only recommendations. There is no provision to enforce compliance on a mandatory basis.

2.4 CENELEC

Within the European Community, the European Standards Committee for Electrical Products [CENELEC Comité Européen de Normalisation Électrotechnique], set up in 1973, is responsible for bringing out harmonized European standards for electrical products. The CENELEC EMC standards are generally identical to CISPR and IEC/TC77 recommendations or contain usually minor “common modifications”. CENELEC implements IEC results in Europe in a uniform manner by common agreement of its members. The subcommittee responsible for EMC is IEC/TC 210.

2.5 Military

Military interest in the field of electromagnetic interference and techniques to control it, has led to important advances in understanding EMI and the technology to achieve EMC. Although the armed forces in several countries documented and published their own standards for limiting EMI, the work by the US military (MIL standards) continues to lead the way in this field.

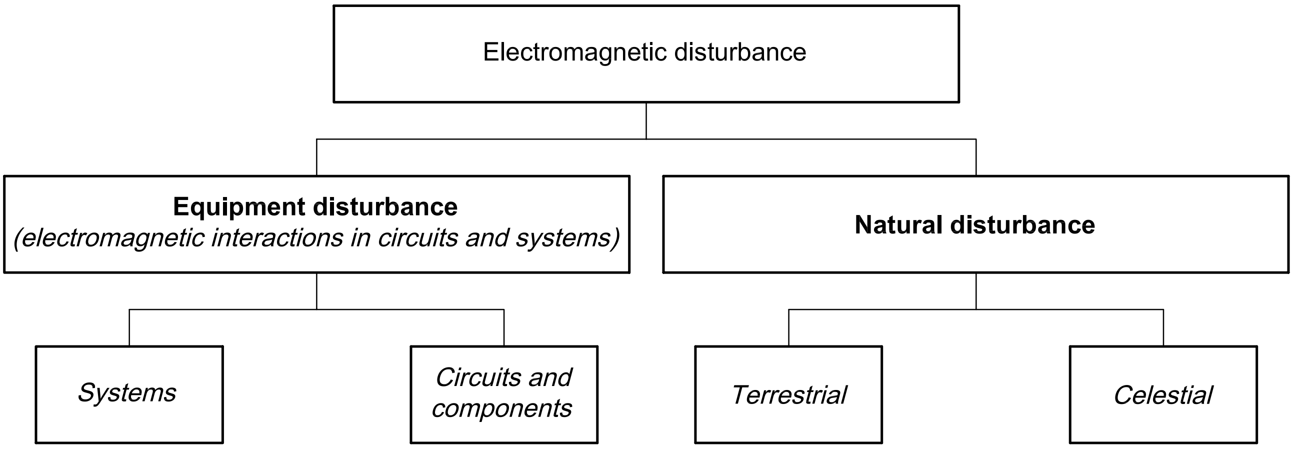
3 Sources of electromagnetic disturbances

3.1 General

Electromagnetic disturbances can be generated intentionally (e.g. telecommunication equipment), non-intentionally (e.g. interactions in circuits and systems) or by natural sources (e.g. atmospheric lightning, electrostatic discharge).

Potential sources of electromagnetic compatibility problems include radio transmitters, power lines, electronic circuits, lightning, lamp dimmers, electric motors, arc welders, solar flares and just about anything that utilizes or creates electromagnetic energy.

An overview of electromagnetic sources is shown in Figure 4.



Systems	Circuits and components	Terrestrial	Celestial
Communication/ Radar/Navigation equipment Fluorescent tube lights Automobile ignition Industrial equipment such as arc welders, heaters, etc. Electric traction Appliances such as microwave ovens, mixers, vacuum cleaners, electric shavers Power supplies Disk drives	Oscillators Switches Motors Filters Relays Nonlinear circuit elements Circuit breakers Magnetic armatures Latching contactors Logic and digital circuits Arcing due to improper contacts Corona	Atmospherics Lightning Electrostatic discharge	Cosmic/Galactic noise Solar noise

NOTE Source: Engineering EMC-IEEE Press.

Figure 4 — Electromagnetic disturbance

3.2 Classification of electromagnetic interference (EMI)

3.2.1 As previously discussed, EMI can be either conducted or radiated.

Some typical examples of EMI are

— picking up a CB radio conversations on your stereo;

— telephone is damaged by lightning-induced surges on the phone line;

— the screen on video display jitters when the fluorescent lights are on;

— new memory board is destroyed by an unseen discharge as you install it;

- the clock on VCR resets everytime your air conditioner kicks in;
- laptop computer interferes with your aircraft's rudder control;
- the airport radar interferes with laptop computer display;
- pacemaker picks up cellular telephone calls;
- a hospital's electrocardiogram machine picks up a television channel.

3.2.2 Conducted interferences are disturbances not intentionally generated and are commonly present on lines connected to power supply networks. Conducted interferences may also appear on data, telephone lines or other metallic paths connecting the source of the interference and the susceptor. Some complex equipment can generate conducted interference well up into the gigahertz frequency range. Different types of equipment that commonly generate conducted interference are shown in Table 1.

Table 1 — Sources of conducted interference

Source	Spectrum
Circuit Breaker Cam Contacts	10 MHz to 20 MHz
Command Programmer	
Signal lines	0,1 MHz to 25 MHz
Power lines	1 MHz to 25 MHz
Computer Logic Box	50 kHz to 20 MHz
Corona	0,1 MHz to 10 MHz
Fluorescent Lamps	0,1 MHz to 3 MHz
Heater Circuits (Contact Cycling)	50 kHz to 25 MHz
Latching Contactor	50 kHz-25 MHz
Motor Armatures	2 MHz to 4 MHz
Mercury Arc Lamps	0,1 MHz to 1,0 MHz
Power Controller	2 kHz to 15 kHz
Power Supply Switching Circuit	0,5 MHz to 25 MHz
Power Transfer Controller	50 kHz to 25 MHz
Vacuum Cleaner	0,1 MHz to1,0 MHz
NOTE Source: Leland H. Hemming. *Architectural EM Shielding Handbook*, IEEE Press.	

3.2.3 Radiated interferences are disturbances appearing as electromagnetic fields.

Radiated interference is caused by atmospheric disturbances, cosmic noise, solar radiation, and manmade sources such as automobiles, industrial, commercial and medical equipment.

3.3 Typical EMC phenomena

3.3.1 General

The following classifications of EMC phenomena provide information to define measurements for the test requirements listed in Clause 5.

3.3.2 Low frequency disturbances (dc to 10 kHz to 20 kHz)

The phenomena of low frequency is mainly present on power supply lines due to load disturbances (e.g. non-linear loads, fluctuating loads, unbalanced three phase voltage system) and faults on power networks. Typical EMC phenomena concerning conducted low frequency disturbances are shown in Table 2.

Table 2 — Low frequency disturbances

EMC phenomena	EMC phenomena source	EMC phenomena effect
Harmonics and Interharmonics	• Discrete frequencies (e.g. static frequency converters, cyclo-converters) • Continuous spectrum (e.g. arc furnaces)	• A short quasi-instantaneous effect; which may range from an occasional malfunctioning up to damage of an electronic component • A long term effect such as excessive substation
Signal voltages in the low voltage supply networks [from 100 Hz to 150 Hz]	• “audio frequencies” in the range 110 Hz to 2 000 Hz (triple control) • “medium frequencies” in the range 3 kHz to 20 kHz (MF-power line carriers) • “radio frequencies” in the range 20 kHz to 150 kHz (RF-power line carriers)	• The operation of sensitive electronic equipment could be affected (e.g. electronic control device, computers)
Voltage fluctuations	• Randomly varying large loads (e.g. arc furnaces) • On-off switching of loads (e.g. motors) • Step voltage changes (due to tap voltage regulators of transformers)	• The operation of sensitive electronic equipment could be affected (e.g. electronic control device, computers)
Voltage dips and short interruptions	• Faults in the low voltage (<1 000 V), medium voltage (1 000 V to 100 kV) or high voltage (>100 kV) networks (short circuits or ground faults)	• Tripping of contactors • Incorrect operation of regulating devices • Commutation failures in converters • Loss of data in computer memories
Three-phase voltage unbalance	• Unbalance in a three-phase voltage system	• Overheating of a.c. rotating machines • Generation of non-characteristic harmonics in electronic power converters
Power frequency variations	• Frequency variation in main power network	• Measurement errors • Loss of synchronization

3.3.3 Conducted transients (nanoseconds to a few milliseconds) and high-frequency disturbances

Conducted transients (nanoseconds to a few milliseconds in duration) are very common on signal and power supply lines coming from atmospheric phenomena (e.g. lightning), switching of inductive or capacitive loads (e.g. relays, capacitors, motors) and faults on power networks which cause interference by coupling with other cables. High frequency conducted disturbances are frequently caused by radio transmitters, ISM (Industrial Scientific and Medical) and emissions from digital processing equipment which are coupled to signal and power cables. The level of electromagnetic interference (i.e. disturbances) is dependent on the shielding, earthing (grounding), over voltage protection etc. of the installations. Typical EMC phenomena concerning conducted transient and high frequency disturbances are shown in Table 3.

Table 3 — Conducted transient and HF-disturbances

EMC phenomena	EMC phenomena source	EMC phenomena effect
Voltage/Current surge (100/1300 μs)	• Blowing of high amperage fuses in low voltage (< 1 000 V) supply network	• The operation of electronic equipment can be affected • The electronic equipment can be damaged
Voltage surge (1,2/50 μs) Current surge (8/20 μs)	• Switching phenomena in the power network (e.g. switching of capacitor banks) • Faults in the power network • Lightning strokes (direct or indirect strokes)	• If the equipment has high impedance relative to that of the source, the surge will produce a voltage pulse on the equipment terminals • If the equipment has a relative low impedance, the surge will produce a current pulse
10/700 μs voltage surge	• Lightning discharges • Any other surge disturbances	• The operation of electrical or electronic equipment can be affected
Fast transient bursts	• Switching of small inductive loads, e.g. relay contacts bouncing (conducted interferences) • Switching of high-voltage switchgear	• The operation of electronic equipment can be affected but generally does not cause damage
Ring wave	• Oscillatory transients due to switching phenomena in residential and industrial low voltage underground cabling network	• The operation of electronic equipment can be affected due to the voltage polarity changes
Damped oscillatory wave	• Oscillatory transients induced in the low voltage circuits by phenomena in the high voltage or medium voltage networks (e.g. switching phenomena, faults, etc.)	• The operation of electrical or electronic equipment can be affected
High frequency induced voltages	Continuous (or quasi-continuous) voltages originated by: • Switching operations • Faults in the high voltage, medium voltage or low voltage networks	• The operation of electrical or electronic equipment can be affected (these disturbances induce oscillatory transients in the secondary circuits despite protective measures; further, they can appear as residual voltages on the screen of shielded cables)

3.3.4 Electrostatic discharge (ESD)

The phenomena of electrostatic discharge results from the friction between two non-conductive materials (one of these could be the "*air*") which causes a static charge. The level of disturbance depends on the installation conditions (such as the type of floor) and climatic conditions (humidity). Typical EMC phenomena concerning electrostatic discharge disturbances are shown in Table 4.

Table 4 — Electrostatic discharge disturbances

EMC phenomena	EMC phenomena source	EMC phenomena effect
Electrostatic discharges	• A person or an object touching the equipment or coming into the vicinity of the equipment	• The operation of electronic equipment can be affected • The electronic equipment can be damaged

3.3.5 Magnetic disturbances

The severity of magnetic disturbances depends on the current flowing through the conductors in the vicinity of the equipment, the distance between the conductors and the presence of neighbouring magnetic materials. Typical EMC phenomena concerning magnetic disturbances are shown in Table 5.

Table 5 — Magnetic disturbances

EMC phenomena	EMC phenomena source	EMC phenomena effect
Power frequency magnetic field Steady magnetic field Short duration magnetic field	• Power frequency current in nearby conductors • Less often, from other devices (e.g. for steady – vicinity of magnets; e.g. for short duration – electromagnetic device)	• The operation of electronic equipment can be affected
Pulse magnetic field	• Lightning strikes	• The operation of electronic equipment can be affected
Damped oscillatory magnetic field	• Switching of high voltage circuits in electricity (power) plants	• The operation of electronic equipment can be affected

3.3.6 Radiated electromagnetic field disturbances

Radiated electromagnetic emissions are generated by radio and television transmitters, radars, digital mobile phones and other forms of communication transmitters. The severity of the disturbance depends on the power of the transmitter and its distance from the susceptible equipment. Interference due to hand-held transceivers is of particular concern. Typical EMC phenomena concerning radiated electromagnetic field disturbances are shown in Table 6.

Table 6 — Radiated electromagnetic field disturbances

EMC phenomena	EMC phenomena source	EMC phenomena effect
Radiated electromagnetic field	• Devices emitting continuous wave radiated electromagnetic energy • Hand-held transceivers (e.g. walkie-talkies, mobile telephones) • Radio and television transmitters • Vehicle radio transmitters • Electromagnetic industrial and intermittent sources • Coupling of electromagnetic field with cables • Radars	• The operation of electronic equipment can be affected

4 EMI/EMC comparison

4.1 Emissions standards comparison

The following worldwide standards were used in the comparison of the emission limits shown in Annex A.

Europe: EN 12015:1998, *Electromagnetic compatibility — Product family standard for lifts, escalators and passenger conveyors — Emission*

Japan: VCCI

China: GB 9254-88

USA: ANSI/IEEE C63.12:1999

FCC Part 15:1999

MIL-SPEC-461E:1999

NOTE Table A.1 is not a complete list of specifications given in MIL-STD-461E. The example given is for ground installations only. The specifications vary depending upon the agency (army, navy and air force) and the applications within that agency (e.g. ship, aircraft, space system). Military specifications are frequently, but not always, more stringent than their commercial counterparts.

4.2 Susceptibility/immunity standards comparison

The following worldwide standards were used in the comparison of the susceptibility/immunity limits shown in Annex B.

Europe: EN 12016:1998, *Electromagnetic compatibility — Product family standard for lifts, escalators and passenger conveyors — Immunity*

Japan: JEIDA-52

China: GB 13926:1988

USA: ANSI/IEEE C63.12:1999

MIL-STD-461E:1999

NOTE Table B.2 is not a complete list of specifications given in MIL-STD-461E. The example given is for ground installations only. The specifications vary depending upon the agency (army, navy and air force) and the applications within that agency (e.g. ship, aircraft, space system). Military specifications are frequently, but not always, more stringent than their commercial counterparts.

5 Test and measurement requirements

The test and measurement methods given in Tables 7 and 8 define the basic principles of how to proceed with EMC measurements:

Table 7 — Emission

Country	Conducted and radiated emissions	Impulse noise	Voltage fluctuation and flicker
Europe	EN 55011:1996	EN 55014:1993	EN 61000-3-3
Japan	CISPR 22		
China	CISPR 22:1985		
USA	ANSI C63.4:1992		

Table 8 — Immunity

Country	Radio frequency electromagnetic field	Electrostatic discharge	Electrical fast transient	Voltage dips Voltage interruption
Europe	EN 61000-4-3 (IEC 801-3)[a]	EN 61000-4-2	EN 61000-4-4	EN 61000-4-11
Japan	IEC 61000-4-3	IEC 61000-4-2	IEC 61000-4-4	IEC 61000-4-11
China	IEC 801-3:1984	IEC 801-2:1984	IEC 801-4:1988	
USA	IEC 61000-4-3; MIL Spec 461E RS103	IEC 61000-4-2	IEC 61000-4-4	IEC 61000-4-11

[a] IEC 801-3:1984 is the standard referenced in prEN 12016:1998, but in the published EN 12016:1998 the reference was incorrectly changed to EN 61000-4-3.

Annex C (Tables C.1 and C.2) shows the test details as frequency ranges and limits for all the norms. The methods used in Europe, Japan and China are similar for both emission and immunity. The right-hand columns indicate if the measurements are basic, not applicable or simply not considered. The measurement methods given in EN 12016 for immunity differentiate between safety circuit and general function but the other standards do not contemplate these functions since they are not elevator specific.

NOTE If the field strength measurement at 10 m cannot be made because of high ambient noise levels, or for other reasons, measurement of Class B EUTs may be made at a closer distance, for example 3 m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance. Care should be taken in the measurement of large EUTs at 3 m at frequencies near 30 MHz, due to near field effects.

6 Future development

6.1 Europe

A new proposal from the European lift industry concerning EMC phenomena not yet covered by the Lift product family standards EN 12015 and EN 12016 will be submitted to CEN/TC 10 for review. The new proposal concerns the following EMC phenomena.

a) Harmonic emissions

Limits for most critical harmonics and total harmonic distortions are being proposed. Harmonic distortions cause problems for other equipment connected to the same power line.

b) Radiated radio frequency electromagnetic fields

More severe immunity level and more appropriate tests are being considered for equipment operating in the frequency range above 500 MHz.

c) Immunity to conducted disturbances induced by radio frequency fields

As it is not always possible to keep homogeneous fields of radiated immunity in the frequency field below 80 MHz, a test procedure for conducted disturbances is being proposed to reproduce test results of immunity to an RF field from 27 MHz to 80 MHz.

d) Radiated electromagnetic field from digital radio telephones

A large number of new radio digital phone [e.g. ground system mobile (telephones)] systems have been recently introduced into the market. The proposal concerns the implementation of a new test.

e) Surge

Surge tests are being proposed to simulate high voltage and frequency disturbances coming from atmospheric phenomena (e.g. direct and indirect lightning strikes) which cause damages or faults in electric and electronic equipment.

6.2 China

Influenced by compulsory EMI/EMC Standards in Europe (i.e. EMC Directives) since 1996, experts in China realized that China's EMC/EMI standards must align with the advanced International EMC/EMI standards. A plan was made to develop EMC/EMI work in three steps. The first step is to review systematically the available standards so as to revise and amend the EMC/EMI standards. The second step is to accredit some test centres as the test authorities. The third step is to do product certification by the accredited test centres in order to assure that the EMC/EMI standard is met.

6.3 United States

The US-EMC Committees (ANSI C63 and IEEE) and the FCC are keenly aware of the needs of US industry and its trading partners to strive for international harmonization of emissions and immunity limits and methods of measurement. However, in the United States it is not likely that immunity requirements will become mandatory so that such requirements as are issued are primarily for guidance to manufacturers, who must independently evaluate the environment and associated performance requirements of their products where they will be used.

The new version of C63.12 has immunity requirements generally similar to those in the European and IEC generic standards [IEC 61000-6-1 (residential) and IEC 61000-6-2 (industrial)], along with a set of requirements for use in so called severe environments (e.g. military or civilian aircraft).

The FCC has also just recently accepted CISPR emission testing techniques in addition to its own and ANSI C63.4. The FCC is also supportive of industry in Mutual Recognition Agreements between the US Government and other countries (e.g. EU).

7 Observations and recommendations

7.1 General

Most of the existing EMC standards for electric and electronic equipment, for lifts, escalators and passenger conveyors are based on CISPR/IEC standards. Requirements are covered by common tests and in many cases the frequency ranges and test limits are the same as CISPR/IEC standards.

7.2 Emission

7.2.1 Observations

The main differences between the European Lift Standard for radiated and conducted emissions, EN 12015, and other CISPR/IEC base standards (standards within this comparison) are due to the fact that lifts have been classified into only Class A equipment. In EN 12015, Class A emission requirements were used because lifts do not have the same characteristics as home appliances.

It is noted that Class A equipment requirements used by the generic standards in this comparison are aligned to the same requirements. Therefore in conclusion, the classification of lifts as Class B is not appropriate because they do not exhibit the same characteristics of equipment commonly used within residential buildings.

7.2.2 Recommendations

The adoption of EN 12015 [EMC *Product Family Standard for Lifts, Escalators and Passenger Conveyors — Emissions*] as an ISO International Standard is proposed for the following reasons.

a) EN 12015 is the same or similar to the generic requirements for Class A of the standards referenced in this comparison from Japan and China.

b) Conducted emissions in EN 12015 for equipment less than 25 amperes is the same as for ANSI/IEEE C63.12 (see Figure A.1, standards comparison of conducted emission, Class A).

c) The FCC requirements for conducted emissions are more stringent than EN 12015 requirements (see Figure A.1). However the FCC limits apply to telecommunication, digital equipment and portable appliances and not transportation equipment.

d) The radiated emissions in EN 12015 are the same as the radiated emissions in ANSI/IEEE C63.12, noting that levels under 30 MHz are not addressed in EN 12015 (see Figure A.5, standards comparison of radiated emission). Testing for radiated emissions below 30 MHz is presently unreliable and therefore not practible for lifts and escalators, and thus not included in EN 12015. (NB: The length of the connecting cable to the equipment is an unknown variable and causes unreliable results.)

e) The radiated emissions in EN 12015 are the same or similar to the radiated emissions of other referenced standards in this comparison.

7.3 Immunity

7.3.1 Observations

Since lifts can be installed in both industrial and residential environments, the European EMI (family product) standard, EN 12016, chose the basic industrial immunity requirements because they were more stringent than the residential requirements.

7.3.2 Recommendations

In the absence of a product specific immunity standard, it is proposed that EN 12016 be adopted as an ISO standard for lift immunity requirements.

Annex A
(normative)

Conducted and radiated emission limits

Table A.1 — Conducted and radiated emission limits

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB (µV) Class A		RE limits dB(µV/m) Class A	CE limits dB(µV) Class B		RE limits dB(µV/m) Class B *(6)*	Basic Standard	Conditions	Notes
				quasi peak	avg.	quasi peak	quasi peak	avg.	quasi peak			
EN12015 – 1998 Europe	Conducted Emissions (CE) *(1)*	MHz	0,15 - 0,50	79,100 & 130 *(2)*	66,90 & 120 *(2)*		NC	NC	NC	EN55011 Group 1	. ports for ac mains	*(1)* CE limits are based on the work of CISPR Subcommittee B *(2)* Limits with rated mains <25 amperes 25-100 amperes, and >100 amperes respectively. *(3)* The limits with rated mains 25-100 amperes decrease with logarithm of frequency. *(4)* The limits with rated mains >100 amperes assume a dedicated power supply from a low impedance source. *(5)* Limits measured at 3 to 10 m distance and based on EN 50081-2:1993 (see 8.1.3 for EN 55011:1991) *(6)* Class B is not relevant for EN12015. *(7)* Limits measured at 30 m distance. *(8)* Electromagnetic emission levels resulting from impulse noise (clicks), shall not exceed the conducted emission (CE) limits specified in the table if the clicks which occur more frequently than 30 times per minute. Electromagnetic emission levels resulting from clicks which occur between 5 and 30 times per minute shall not exceed the conducted emission (CE) limits specified in the table raised by a value of 20 x log 30 N dB (µV) (where N is the number of clicks per min). Electromagnetic emissions levels resulting from isolated clicks shall not exceed the limits specified in EN 55014:1993. There are no limits for clicks which occur less than 5 times per minute.
			0,5 - 5,0	73,86 & 125 *(2)*	60, 76 & 115 *(2)*							
			5,0 - 30	73,90-70 & 115 (2) (3) (4)	60, 80-60 & 105 (2) (4)							
	Radiated Emissions (RE)	MHz	30 - 230			30 *(7)* 40 *(5)*	NC	NC	NC	EN55011 Group 1	.enclosure ports	
			230 - 1000			37 *(7)* 47 *(5)*						
	Impulse Noise *(8)*	clicks per minute (N)	isolated	EN55014:1993			NC	NC	NC	EN55014 Group 1	. ports for ac mains	
			<5	No limits								
			5 ≤ ≤ 30	20 log 30/N								
			>30	Limits specified in conducted emission								

Table A.1 — Conducted and radiated emission limits (continued)

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB(µV) Class A		RE limits dB(µV/m) Class A	CE limits dB(µV) Class B		RE limits dB(µV/m) Class B	Basic Standard	Conditions	Notes:
				quasi peak	avg.	quasi peak	quasi peak	avg.	quasi peak			
EN12015 - 1998 (Europe)	Voltage fluctuation and flicker limits	short-term flicker (min)	≤ 1,0							EN61000-3-3	. for equipment with ≤ 16 amperes input per phase	
		Long-term flicker (min)	≤ 0,65									
		Relative Steady-state voltage change (%Vdc)	≤ 3									
		Max relative voltage change (%Vdc)	≤ 4									
		relative voltage change characteristic (V)	d(f) ≤ 3 % for more than 200ms									

Table A.1 — Conducted and radiated emission limits (continued)

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB(µV) Class A		RE limits dB(µV/m) Class A	CE limits dB(µV) Class B		RE limits dB(µV/m) Class B	Basic Standard	Conditions	Notes
				quasi peak	avg.	quasi peak	quasi peak	avg.	quasi peak			
VCCI (Japan)	Conducted Emissions (CE)	MHz	0,15 - 0,50	79	66		66 - 56	56 - 46		CISPR22	- ports for ac mains	(1) EMI/EMC regulations in Japan are voluntary. The Voluntary Control Council for Interference (VCCI) has set limits for conducted and radiated emissions for information technology products. The VCCI is assisted in this effort by the Japan Electromatic Industries Development Association (JEIDA). (2) Limits are measured at 10 m distance.
			0,5 - 5,0	73	60		56	46				
			5,0 - 30	73	60		60	50				
	Radiated Emissions (RE)	MHz	30 - 230			40 *(2)*			30 *(2)*		- enclosure ports	
			230 - 1000			47 *(2)*			37 *(2)*			
	Impulse Noise	Clicks per minute (N)	isolated	NC	NC							
			<5									
			5 ≤ N ≤ 30									
			>30									
	Voltage fluctuation and flicker limits	NC										

Table A.1 — Conducted and radiated emission limits (continued)

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB(μV) Class A		RE limits dB(μV/m) Class A	CE limits dB(μV) Class B		RE limits dB(μV/m) Class B	Basic Standard	Conditions	Notes
				quasi peak	avg.	quasi peak	quasi peak	avg.	quasi peak			
China GB9254-88	Conducted Emissions (CE)	MHz	0,15 - 0,50	79	66		66-56 *(1)*	56-46 *(1)*		CISPR22-1985		*(1)* decreasing linearly with logarithm of the frequency. *(2)* Limits measured at 30 m distance. *(3)* Limits measured at 10 m distance.
			0,5 - 5,0	73	60		56	46				
			5,0 - 30	73	60		60	50				
	Radiated Emissions (RE)	MHz	30 - 230			30 *(2)*			30 *(3)*			
			230 - 1000			37 *(2)*			37 *(3)*			
	Impulse Noise	Clicks per minute (N)	isolated									
			<5									
			5 ≤ N ≤ 30									
			>30									
	Voltage fluctuation and flicker limits	NC	NC									

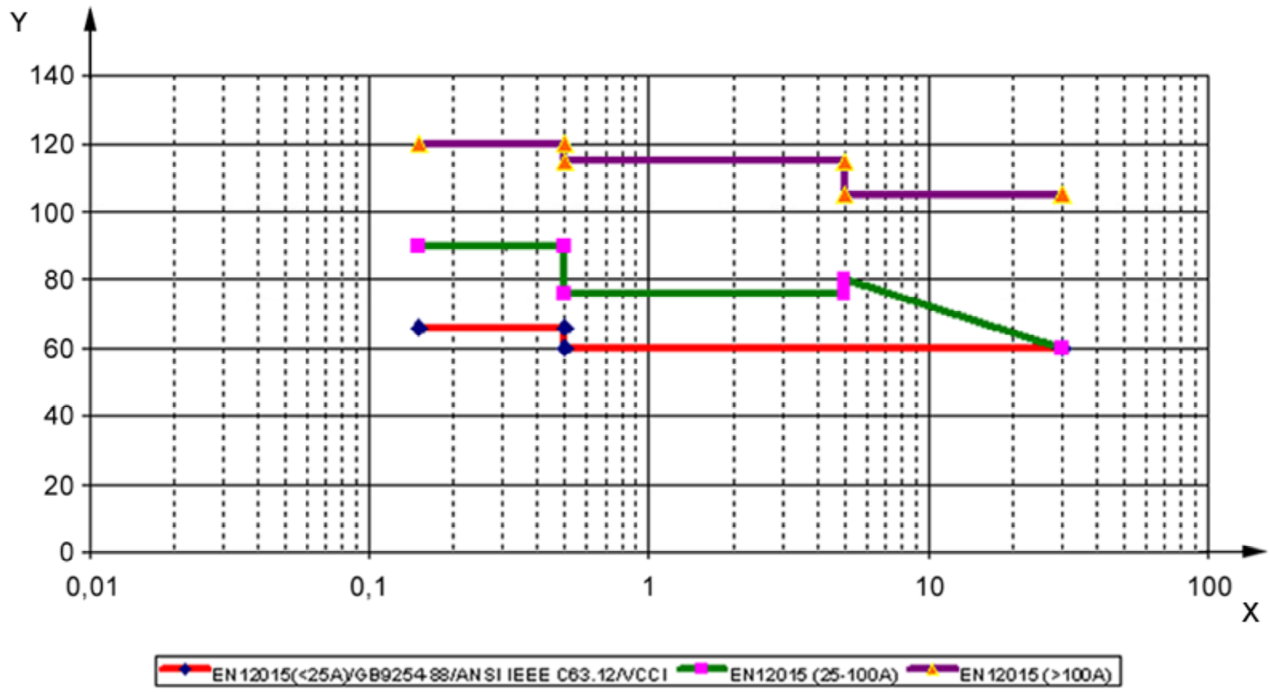
Table A.1 — Conducted and radiated emission limits (continued)

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB(µV) Class A *(1)* quasi peak	CE limits dB(µV) Class A *(1)* avg.	RE limits dB(µV/m) Class A *(1)* quasi peak	CE limits dB(µV) Class B *(1)* quasi peak	CE limits dB(µV) Class B *(1)* avg.	RE limits dB(µV/m) Class B *(1)* quasi peak	Basic Standard	Conditions	Notes
ANSI/IEEE C63.12 – 1999 (USA)	Conducted Emissions (CE)	MHz	0,15 - 0,5	79	66		66-56 *(2)*	56-46 *(2)*		CISPR22 and FCC		*(1)* Limits measured at 10 m distance *(2)* decreasing linearly with logarithm of the frequency. *(3)* Limits measured at 3 m distance. *(4)* These are common mode conducted emissions. This is one method of making the test measurement that uses a current probe to measure the common-mode currents in shielded and non-shielded cables given in ANSI C63.4-1992. *(5)* "f" is in KHz. *(6)* "f" is in MHz. *(7)* The limit in this frequency range is still under consideration along with its extension to 60 GHz.
			0,5 - 5,0	73	60		56	46				
			5,0 - 30	73	60		60	50				
			0,01 - 0,8 *(4)*				166-40 logf dB(µA) *(5)*					
			0,8 - 30 *(4)*				48-20 logf dB(µA) *(6)*					
	Radiated Emissions (RE)	MHz	< 0,8			98-20 logf *(1)(5)*			88 - 20 logf *(1)(5)*			
			0,8 - 230			40 *(1)*			30 *(1)*			
			230 - 1000			47 *(1)*			37 *(1)*			
			1000-10 000 (7)			47 *(1)*			37 *(1)*			
	Impulse Noise											
	Voltage fluctuation and flicker limits		NC	NC								
FCC Part 15 - 1999 (USA)	Conducted Emissions (CE)	MHz	0,45 - 1,705	60			47.9					
			1,705 - 30	69,5			47.9					
	Radiated Emissions (RE)	MHz	30 - 88			39 *(1)*			40 *(3)*		Based upon work done at FCC laboratories	
			88 - 216			43,5 *(1)*			43,5 *(3)*			
			216 - 960			46,4 *(1)*			46 *(3)*			
			>960			49 *(1)*			54 *(3)*			
	Impulse Noise		NC	NC								
	Voltage fluctuations and flicker limits		NC	NC								

Table A.1 — Conducted and radiated emission limits (concluded)

Standard	Environmental Phenomena	Units	Test Levels	CE limits dB(μV) Ground Installations *(1)*		RE limits dB(μV/m) Ground Installations *(1)*		CE limits dB(μV) Class B		RE limits dB(μV/m) Class B		Basic Standard	Conditions	Notes
				peak	avg.	peak	avg.	quasi peak	avg.	quasi peak	avg.			
MIL-SPEC – 461E – 1999 *(7)* **(USA)**	Conducted Emissions (CE)	MHz	0,01 - 0,5 0,5 - 10	94 - 60 *(2)* 60 *(3)*								CE102	Input Power Leads	*(1)* Data in this table is based on requirements for Army, Navy, and Air Force Ground Installations. *(2)* The limits decrease with the logarithm of the frequency from 10 KHz to 500 KHz *(3)* The limits are relaxed dependent upon the source voltage level (AC & DC) as follows: Nominal Voltage — Limit 28V — Basic 115V — 6dB 220V — 9dB 270V — 10dB 440V — 12dB *(4)* The limits increase with the logarithm of the frequency from 100 MHz to 18 GHz *(5)* For Navy fixed and Air Force installations. *(6)* For Navy mobile and Army installations. *(7)* 461E combines 461D and 462D.
	Radiated Emissions (RE)	MHz	2 - 100 100 MHz - 18 GHz			44 44 - 89 *(4) (5)*						RE102	Equipment and subsystem enclosures, and all interconnecting cables	
			2 - 100 100 MHz - 18 GHz			24 24 - 69 *(4) (6)*								
	Impulse Noise		NC	NC	NC									
	Voltage fluctuations and flicker limits	NC	NC											

NC means “Not considered”.

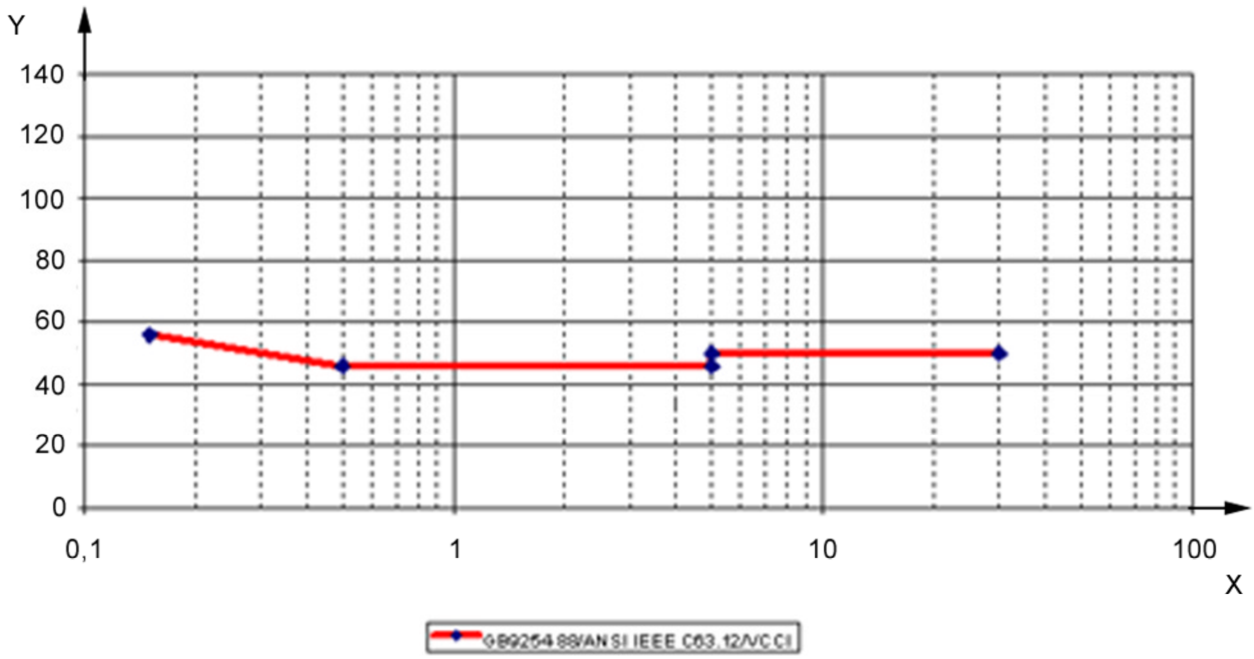


Key

X = frequency (MHz)

Y = average level (dBµV)

Figure A.1 — Standards comparison of conducted emission — Class A — Average

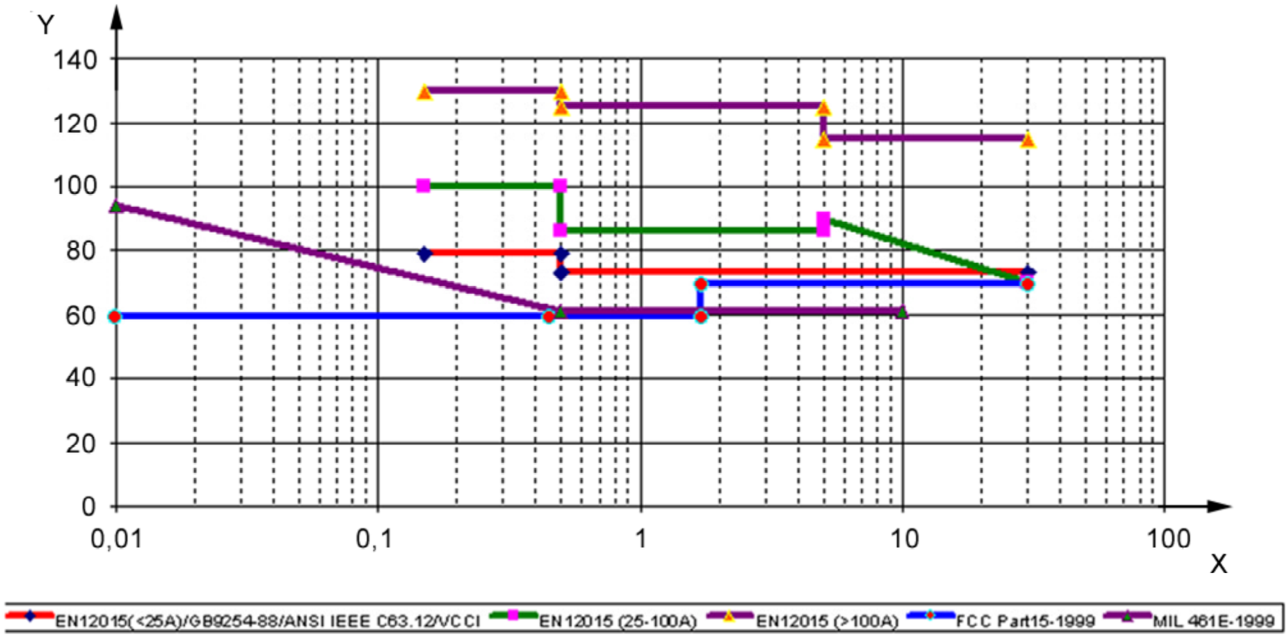


Key

X = frequency (MHz)

Y = average level (dBµV)

Figure A.2 — Standards comparison of conducted emission — Class B — Average

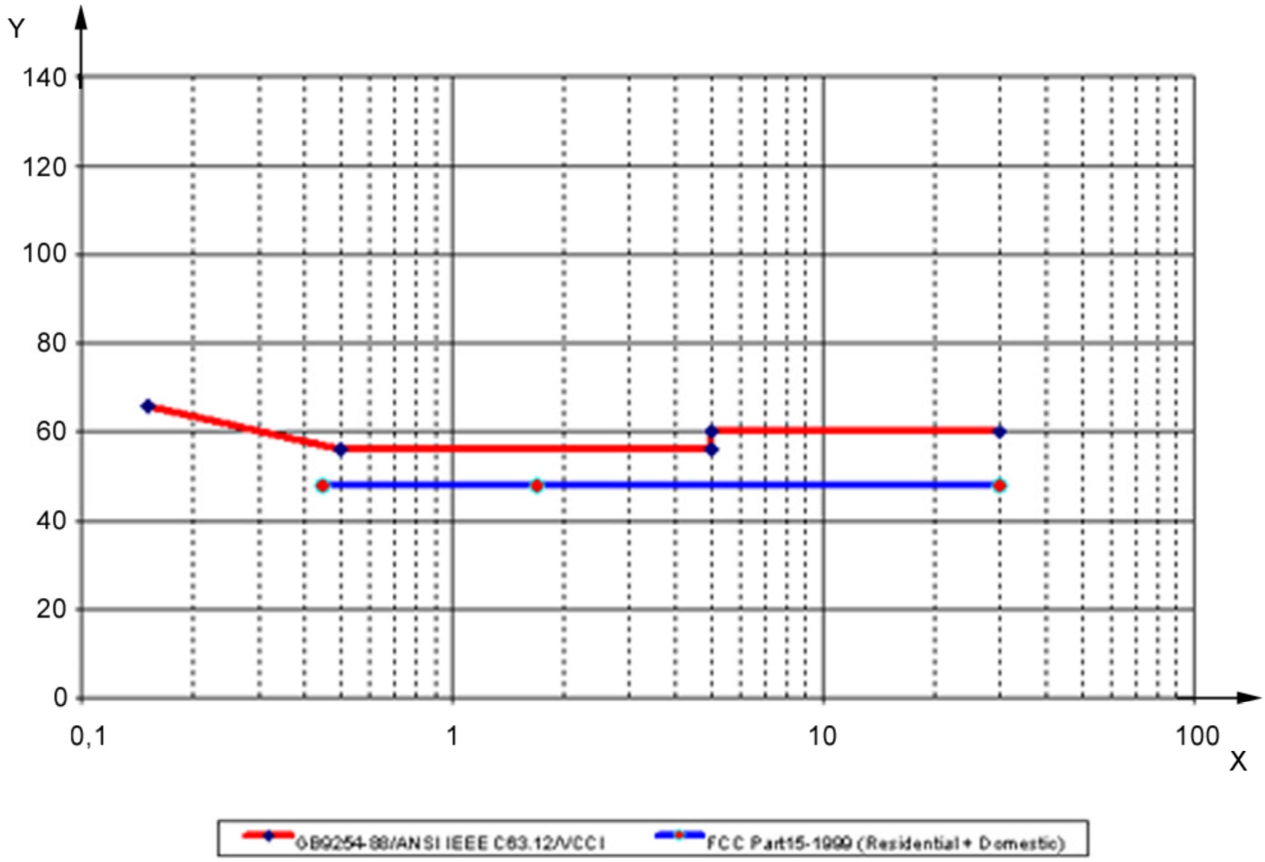


Key

X = frequency (MHz)

Y = quasi-peak level (dBμV)

Figure A.3 — Standards comparison of conducted emission — Class A — Quasi-peak

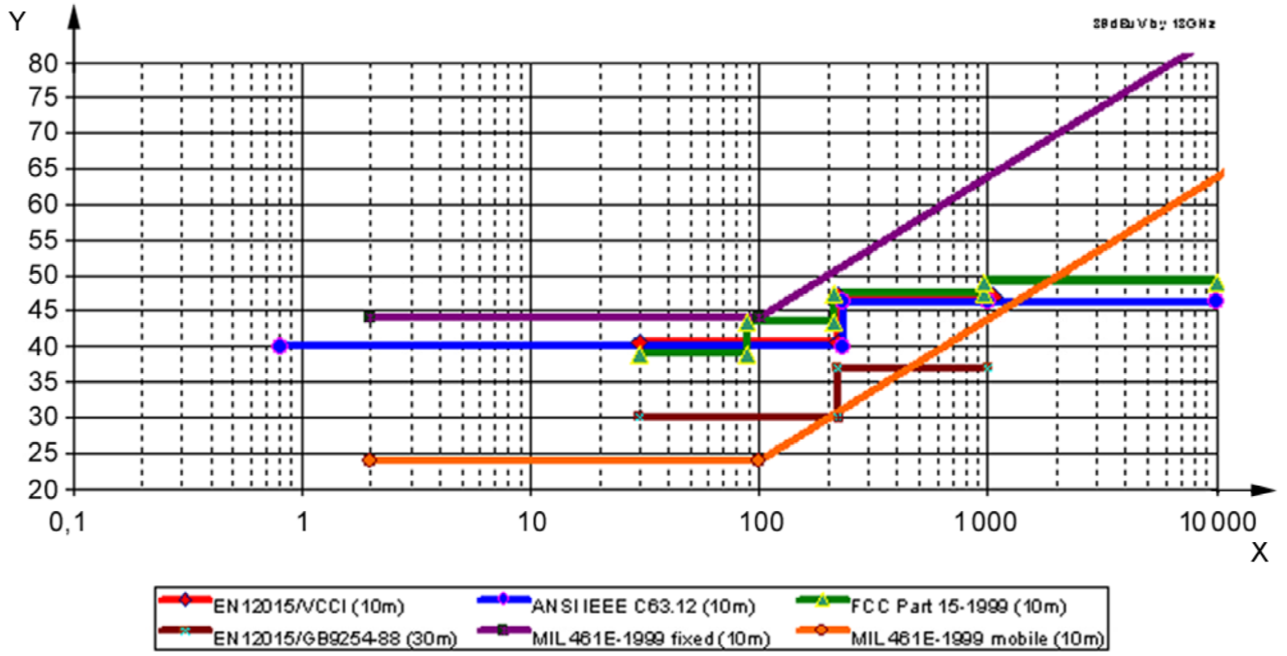


Key

X = frequency (MHz)

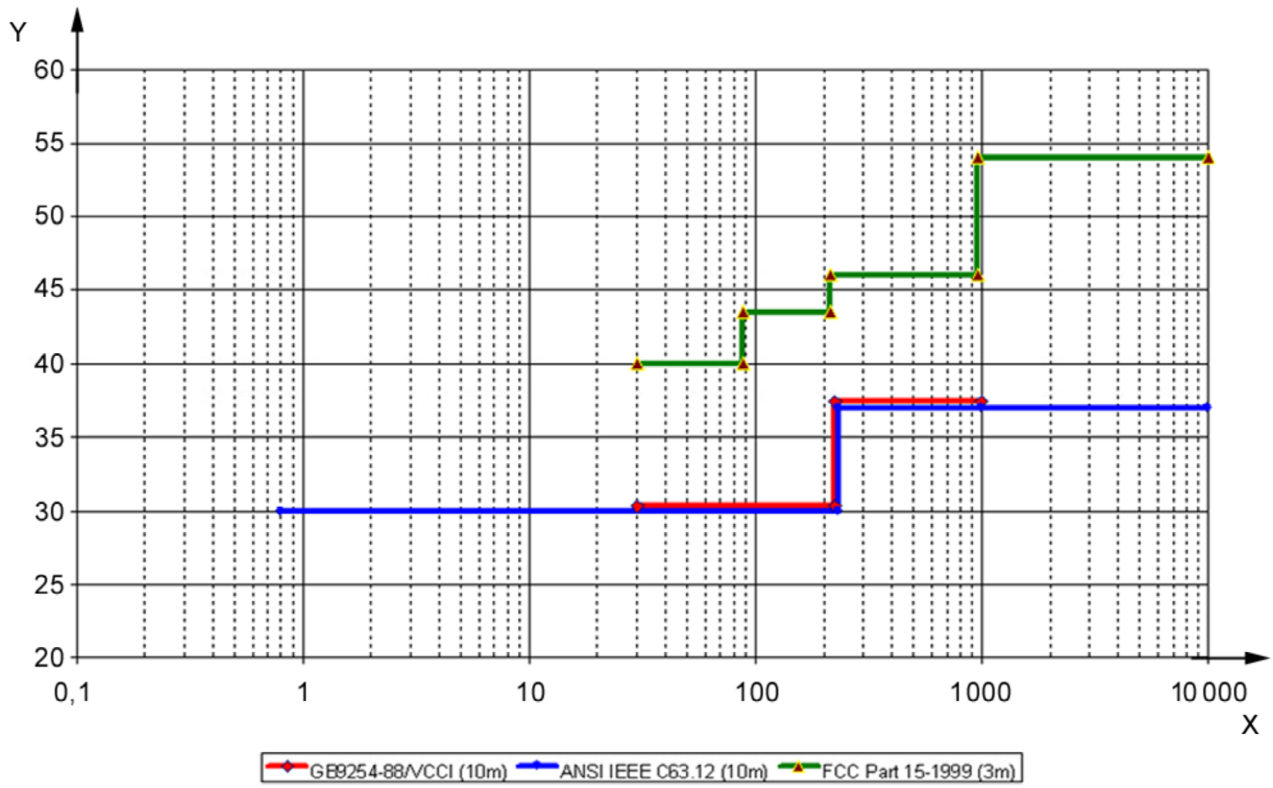
Y = quasi-peak level (dBµV)

Figure A.4 — Standards comparison of conducted emission — Class B — Quasi-peak



Key
X = frequency (MHz)
Y = quasi-peak level (Peak level for MIL 461E) (dBµV)

Figure A.5 — Standards comparison of radiated emission — Class A — Quasi-peak (except peak for MIL 461E)



Key
X = frequency (MHz)
Y = quasi-peak level (dBµV)

Figure A.6 — Standards comparison of radiated emission — Class B — Quasi-peak

Annex B
(normative)

Susceptibility/Immunity

Table B.1 — Susceptibility/Immunity

		Europe				Japan			China			USA				
		EN12016: EMC Product family standard for lifts, escalators and passenger conveyors. Immunity *(4)*				**JEIDA-52 (Japan Electronic Industries Development Association)** *(1)*			**(GB13926)**			**ANSI/IEEE C63.12-1999** *(1)* (FCC & MIL-STD-461E, See page 3 of 3)				
Environmental Phenomena	Units	Test Levels: General Function Circuit (1)	Test Levels: Safety Circuit (2)	Basic Standard	Conditions	Test Levels	Basic Standard	Conditions	Test Levels	Basic Standard	Conditions	Test Levels: Residential	Test Levels: Industrial	Test Levels: Severe *(2)*	Basic Standard	Conditions
Radio frequency electromagnetic field	MHz	27-500	27-500	See Note *(6)*	enclosure ports	≤ 80-1000	IEC61000-4-3 *(3)*	enclosure ports	27-500	IEC801-3:1984	enclosure ports	0,01-10 000	0,01-10 000	0,01-10 000	RS103 IEC 61000-4-3:1995	enclosure ports
	V/m (rms)	3 *(3)*	10			3			3			3	10	200		
Electrostatic Discharge (kV)	Contact (kV)	4	6	EN61000-4-2:1995	enclosure ports	4	IEC61000-4-2 *(3)*	enclosure ports	4	IEC801-2:1984	enclosure ports	4	4	6	IEC 61000-4-2:1995	enclosure ports
	Air (kV)	8	15			8			8			8	8	15		
Electrical Fast Transient	Rise (ns) Tr	5	5		ports for signal & data lines not involved in process control, etc.	5		signal & tele-communication ports	5	IEC801-4:1988	input ac power ports	**5**	**5**	**5**	IEC 61000-4-4:1995	Power & signal ports
	Width (ns)Th	50	50	EN61000-4-4:1995	ports for process measurement & control lines	50	IEC61000-4-4 *(3)*	input ac & dc power ports	50			**50**	**50**	**50**		
	Repeat Freq. (kHz)	5	2,5-5,5		input and output ac & dc power ports	5			Not Considered			5	5	5		
	Peak V (kV)	0,5; 1,0; 2,0	2,0; 4,0			0,5			0,5; 1,0			0,5; 1,0	2	1,0; 2,0		

Table B.1 — Susceptibility/Immunity (continued)

		Europe				Japan			China			USA				
		EN12016: EMC Product family standard for lifts, escalators and passenger conveyors. Immunity *(4)*				**JEIDA-52 (Japan Electronic Industries Development Association)** *(1)*			**(GB13926)**			**ANSI/IEEE C63.12-1999** *(2) (1)* (FCC & MIL-STD-461E, See page 3 of 3)				
Environmental Phenomena	Units	Test Levels: General Function Circuit *(1)*	Test Levels: Safety Circuit *(2)*	Basic Standard	Conditions	Test Levels	Basic Standard	Conditions	Test Levels	Basic Standard	Conditions	Test Levels: Residential	Test Levels: Industrial	Test Levels: Severe *(2)*	Basic Standard	Conditions
Voltage Dips	% reduction (ms)	N/A	30% - 10ms (1/2 period) 60% - 100ms (5 periods)	EN61000-4-11: 1994	input & output ac ports at ≤100A per phase Applicable to single-phase systems only; three phase tests are under consideration. Not applicable to input ports intended for connection to dedicated non-rechargeable power.	30%	IEC61000-4-11 *(3)*	input ac ports	-	N/A		30% (1/2 period) 60% (6 periods)	30% 60%	60% 80%	IEC 61000-4-11:1995	input ports
Voltage Interruptions	% reduction (ms)	N/A	>95% 5000ms			>95% 5000ms (250 periods)			-			> 95% 300 periods (3)	> 95% 300 periods (3)	> 95% 300 periods (3)		
Performance Criteria		A,B *(5)*	D *(5)*			A,B,C *(2)*						B, C	B, C	B, C		
General Comments/Notes		(1) Test values for ports containing general function circuits only (2) Test values for ports containing safety circuits (3) Except for the ITU ISM frequencies 27,120 MHz, 40,680 MHz and 433,920 MHz where the level shall be 10 V/m (rms, unmod) (4) The ASME/ANSI A17.1 & CAN/CSA B44 Lift Committee have approved the adoption of EN12016 (5) See EN12016 for definitions (6) IEC 801-3:1984 is the standard referenced in prEN12016-1998, but in the published EN12016-1998 the referenced was incorrectly changed to EN61000-4-3.				(1) JEIDA-52 is essentially the same as CISPR24 (2) See JEIDA-52 for definitions (3) Edition not provided						(1) C63 Standards are in many instances similar to IEC/CISPR Standards. (2) Limited to equipment such as radio transmitting antennas, radars, etc. where high electro-magnetic fields can appear near the equipment. High level transients can also appear in power conductors in large switching stations. (3) Periods refer to the supply.				

Table B.2 — Susceptibility/Immunity for MIL-SPEC 461E - 1999

Standard	Environmental Phenomena	Frequency Range/ Test Levels	CS test level db (µv) Ground Installations *(1)*		RS test level V/m (rms) Ground Installations *(1)*		Basic Standard	Conditions	Notes
			quasi peak	avg.	quasi peak	avg.			
MIL-SPEC-461E - 1999 (USA)	Conducted (CS)	30 - 5kHz 5kHz – 150kHz		136 136 – 106,5 *(2)* *(3)*			CS101	Input Power Leads	*(1)* Data in this table is based on requirements for Army, Navy, and Air Force Ground Installations. *(2)* The limits decrease with the logarithm of the frequency from 5 kHz to 50 kHz *(3)* Input Power source voltage above 28 volts. *(4)* Input Power source voltage 28 volts or below *(5)* The limits increase with the logarithm of the frequency from 10 kHz to 1 MHz. *(6)* Navy and Air Force *(7)* Army
		30 - 5kHz 5kHz - 150 kHz		126 126 – 96,5 *(2)* *(4)*					
		10kHz - 1MHz 1 MHz - 30 MHz		43 – 83 dB(µA) *(5)* 83 dBµA *(6)*			CS114	All interconnecting cables including power cables	
		10kHz - 1 MHz 1MHz - 30MHz		49 – 89 dB(µA) *(5)* 89 dB(µA) *(7)*					
	Radiated (RS)	10kHz - 2MHz				10 *(6)* 20 *(7)*	RS103	Equipment and subsystem enclosures and all interconnecting cables	
		2 MHz - 30MHz				10 *(6)* 50 *(7)*			
		30MHz - 1GHz				10 *(6)* 50 *(7)*			
		1GHz - 18GHz				50 *(6)*, *(7)*			

NOTE Regarding FCC, although there are no requirements for **susceptibility** the “parties responsible for equipment compliances” are advised to consider susceptibility to interference (e.g. proximity to high power broadcast stations).

Annex C
(normative)

Emissions/Immunity

Table C.1 — Emissions

EMISSION						
EMC test and measurement procedures	**Test details** (Freq. Ranges, limits)	**Europe (E)** Existing standard for lifts EN 12015-1998	**Japan (J)** No lift standard VCCI	**China [C]** No lift standard GB 9254-1998	**USA (U)** No lift standard	
					C63.12-1999	FCC-1999, Part 15
Conducted Emission Class A	0,45 - 1,705 MHz					B
	1,705 - 30 MHz					B
E:EN 55011:96	0,15 - 0,5 MHz	B	B	B	B	
J: CISPR22	0,5 - 5 MHz	B	B	B	B	
C: CISPR22:1985	5 - 30 MHz	B	B	B	B	
U: ANSI C63.4-1992	60 dB (µV)					B
	69,5 dB (µV)					B
	79/66 dB (µV)	B	B	B	B	
	73/60 dB (µV)	B	B	B	B	
	100/90 dB (µV)	B				
	86/76 dB (µV)	B				
	90 - 70/80 - 60 dB (µV)	B				
	130 - 120 dB (µV)	B				
	125 - 115 dB (µV)	B				
	115 - 105 dB (µV)	B				
Conducted Emission Class B	0,45 - 1,705 MHz	NC				B
	1,705 - 30 MHz	NC				B
E: EN 55011:96	0,01 - 30 MHz	NC			B	
J: CISPR22	0,8 - 30 MHz	NC			B	
C: CISPR22:1985	0,15 - 0,5 MHz	NC	B	B	B	
U: ANSI C63.4-1992	0,5 - 5 MHz	NC	B	B	B	
	5 - 30 MHz	NC	B	B	B	
	47,9 dB (µV)	NC				B
	66 - 56/56-46 dB (µV)	NC	B	B	B	
	56/46 dB (µV)	NC	B	B	B	
	60/50 dB (µV)	NC	B	B	B	
	160 - 40 log f dB(µA)	NC			B	
	48 - 20 log f dB(µA)	NC			B	

Table C.1 — Emissions (continued)

EMISSION						
EMC test and measurement procedures	**Test details** (Freq. Ranges, limits)	**Europe (E)** Existing standard for lifts EN 12015-1998	**Japan (J)** No lift standard VCCI	**China [C]** No lift standard GB 9254-1998	**USA (U)** No lift standard	
					C63.12-1999	FCC-1999, Part 15
Radiated Emission	< 0,8 MHz				B	
Class A	0,8 - 230 MHz				B	
	30 - 230 MHz	B	B	B	B	
	0,230 - 1 GHz	B	B	B	B	
E:EN 55011:96	1 - 10 GHz				B	
J:CISPR22	30 - 88 MHz					B
C: CISPR22:1985	88 - 216 MHz					B
U: ANSI C63.4-1992	216 - 960 MHz					B
	> 960 MHz					B
	98 - 20 logf				B	
	30 dB (30 m) (µV/m)	B	Same as 40 dB(10 m)	B	Same as 40 dB(10 m)	
	37 dB (30 m) (µV/m)	B	Same as 47 dB(10 m)	B	Same as 47 dB(10 m)	
	40 dB(10 m) (µV/m)	B (3-10 m)	B	Same as 30 dB(30 m)	B	
	47 dB (10 m) (µV/m)	B (3-10 m)	B	Same as 37 dB(30 m)	B	
	39 dB (10 m) (µV/m)					B
	43,5 dB (10 m) (µV/m)					B
	46,4 dB (10 m) (µV/m)					B
	49 dB (10 m) (µV/m)					B
	< 0,8 MHz	NC			B	
Radiated emission	0,8 - 230 MHz	NC			B	
Class B	30 - 230 MHz	NC	B	B	B	
	0,230 - 1 GHz	NC	B	B	B	
E: EN 55011:96	1 - 10 GHz	NC			B	
J: CISPR22	30 - 88 MHz	NC				B
C: CISPR22:1985	88 - 216 MHz	NC				B
U: ANSI C63.4-1992	216 - 960 MHz	NC				B
	> 960 MHz	NC				B
	30 dB (10 m) (µV/m)	NC	B	B	B	
	37 dB (10 m) (µV/m)	NC	B	B	B	
	88 - 20 logf (µV/m)	NC			B	
	40 dB (3 m) (µV/m)	NC				B
	43,5 dB (3 m) (µV/m)	NC				B
	46 dB (3 m) (µV/m)	NC				B
	54 dB (3 m) (µV/m)	NC				B

Table C.1 — Emissions (concluded)

EMISSION						
EMC test and measurement procedures	**Test details** (Freq. Ranges, limits)	**Europe (E)** Existing standard for lifts EN 12015-1998	**Japan (J)** No lift standard VCCI	**China [C]** No lift standard GB 9254-1998	**USA (U)** No lift standard	
					C63.12-1999	FCC-1999, Part 15
Impulse noise	Isolated EN 55014	B				
Class A	< 5 – No Limits	B				
(click/min) E: EN 55014:1993	5 ≤ N ≤ 30 (clicks) limit increase of 20 log 30/N	B	NC	NC	NC	NC
	> 30 clicks EN 12015	B	NC	NC	NC	NC
Voltage Fluctuation and Flicker E: EN 61000-3-3	≤ 1,0 short term (min) ≤ 0,65 long term (min) ≤ 3 (%)Vdc ≤ 4 max. relative voltage change (%)Vdc d(f) ≤ 3 % for more than 200 ms (V)	B B B B B	NC	NC	NC	NC

NC = Not considered

B = Basic requirement

NOTE FCC code is mandatory and ANSI/IEEE C63.12 is voluntary in the USA.

Table C.2 — Immunity

Immunity					
EMC Test and Measurement Procedures	**Test details** (Freq. Ranges, limits)	**Europe (E)** Existing lift standard EN 12016	**Japan (J)** No lift standard JEIDA-52	**China [C]** No lift standard GB 13926	**USA (U)** No lift standard ANSI 63.12-1999
Radio Frequency **Electromagnetic Field** E: See Note *(1)* J: IEC 61000-4-3 C:IEC 801-3:1984 U:IEC 61000-4-3	27 - 500 MHz	B		B	
	80 - 1 000 MHz	Implemented in future	B		
	0,01 - 10 000 MHz				B
	3 V/m	For general function circuits	B	B	Residential
	200 V/m				Severe
	10 V/m	For safety circuits			Industrial
Electrostatic discharge E:EN 61000-4-2 J:IEC 61000-4-2 C:IEC 801-2:1984 U: IEC 61000-4-2	4 kV (contact)	For general function circuits	B	B	Residential & Industrial
	6 kV (contact)	For safety circuits			Severe
	8 kV (air)	For general function circuits	B	B	Residential & Industrial
	15 kV (air)	For safety circuits			Severe
Electrical Fast Transient E:EN 61000-4-4 J:IEC 61000-4-4 C:IEC 801-4:1988 U: IEC 61000-4-4	0,5 kV (peak V)	For general function circuits	B	B	Residential
	1 kV (peak V)	For general function circuits		B	Residential or Severe
	2 kV (peak V)	For general function/safety circuits			Industrial or Severe
	4 kV (peak V)	For safety circuits			
Voltage dips **Voltage Interruption** E:EN 61000-4-11 J:IEC 61000-4-11 U: IEC 61000-4-11:1995	30 % - 10 ms (1/2 p)	B	B		
	60 % - 100 ms (5 p)	B			
	> 95 % - 5 s	B	B		
	> 95 % - 300 p				B
	30 % - 1/2 p				Residential & Industrial
	60 % - 6 p				Residential & Industrial
	60 % - 1/2 p				Severe
	80 % - 6 p				Severe

NOTE (1): IEC 801-3:1984 is the standard referenced in prEN 12016-1998, but in the published EN 12016-1998 the reference was incorrectly changed to EN 61000-4-3.

B = Basic requirement

Annex D
(informative)

EMI/EMC units

Radiated emissions and radiation susceptibility are measured in terms of field strength (volts per metre, or tesla). Conducted emissions and conducted susceptibility are measured as voltages and currents (volts, or amperes).

Single-frequency or very narrowband measurements are expressed as amplitude, whereas broadband measurements are expressed on a per unit bandwidth (e.g. per hertz) basis.

Voltage

Volts:

V = 10^3 mV (millivolts) = 10^6 µv (microvolts)

dB(V) = dB above 1 V reference level; 20 $\log_{10}$ [(V in volts)/1 volt]

dB(mV) = dB above 1 mV reference level

dB(µV) = dB above 1 µv reference level

Current

Amperes: 10^3 mA (milliamperes) = 10^6 µA (microamperes)

dB(A), dB(mA), dB(µA)

Power

Watts: 10^3 mW (milliwatts) = 10^6 µW (microwatts) = 10^{12} pW (picowatts)

dB(W), dB(mW), dB(µW)

dB(W) = 10 $\log_{10}$ [(P in watts)/1 watt]

Electric field

V/m = volts per metre

dB(V/m), dB(mV/m), etc.

Annex E
(informative)

Frequency spectrum

Table E.1 — Frequency spectrum

Frequency subdivision	Frequency range	Equipment
ELF (extremely low)	30 Hz to 300 Hz	Submarine communication
VF (voice)	300 Hz to 3 kHz	Voice frequency on telephone
VLF (very low)	3 kHz to 30 kHz	Sonar transoceanic radio
LF (low)	30 kHz to 300 kHz	Radio beacons, navigational aids
MF (medium)	300 kHz to 3 000 kHz (3 MHz)	Coast guard communication, AM radio
HF (high)	3 MHz to 30 MHz	Telegraph, shortwave and AM radio
VHF (very high)	30 MHz to 300 MHz	FM and mobile radio
UHF (ultra high)	300 MHz to 3 000 MHz (3 GHz)	Coaxial cables, microwave and surveillance radio
SHF (super high) (microwave)	3 GHz to 30 GHz	Satellite communication, marine and weather radar
EHF (extremely high)	30 GHz to 300 GHz	Imaging (mapping)
(undesignated)	300 GHz to 3 000 GHz	Optical fibre

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