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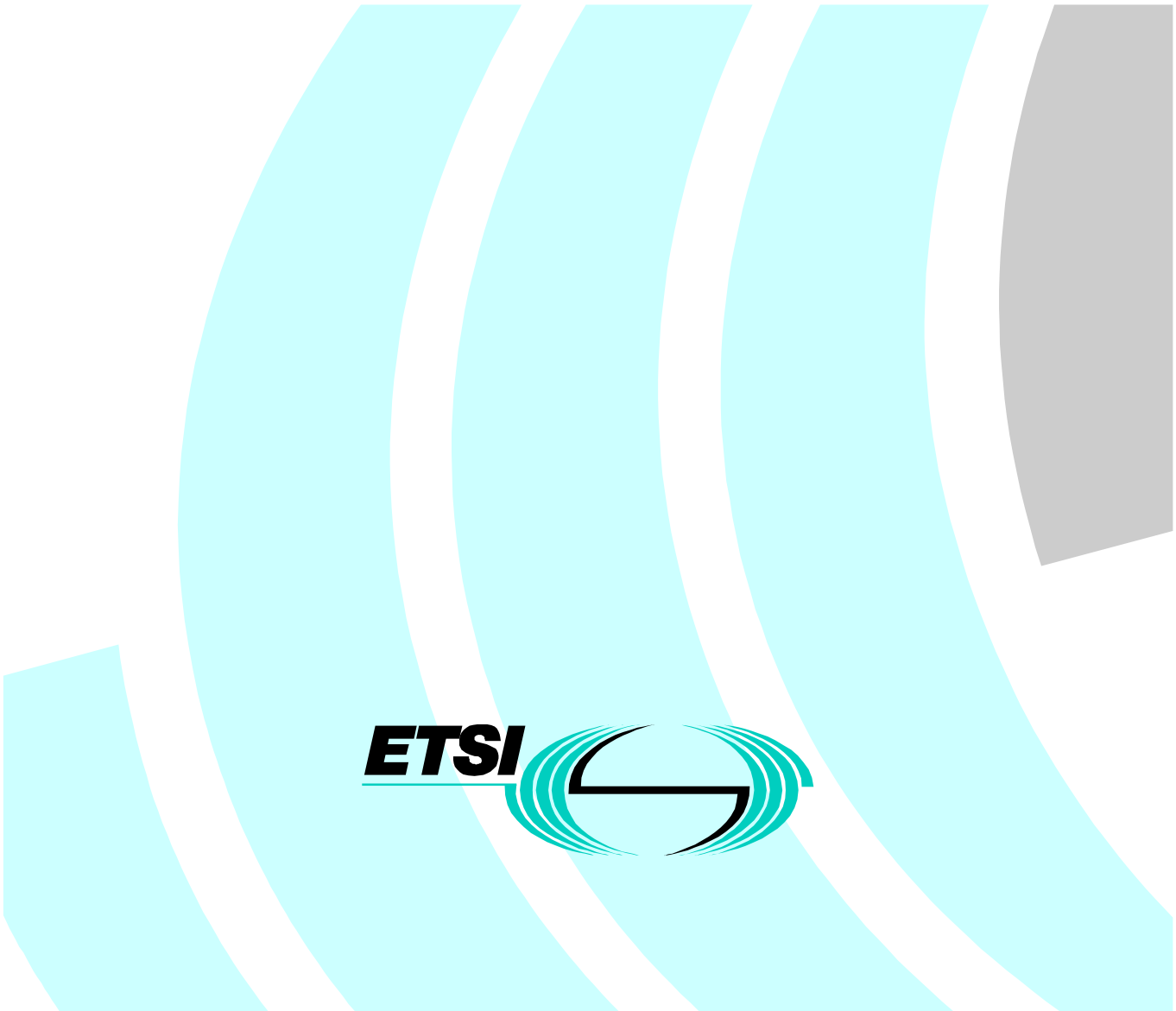
Candidate Harmonized European Standard (Telecommunications series)

Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio paging equipment



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Contents

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Public Enquiry phase of the ETSI standards Two-step Approval Procedure.

The present document has been produced by ETSI in response to a mandate from the European Commission issued under the Council Directive 98/34/EC [23] (as amended) laying down a procedure for the provision of information in the field of technical standards and regulation.

The present document, together with one or more of the following: ETS 300 133 [16], [17], ETS 300 224 [19], and ETS 300 719-1 [20], is intended to become a Harmonized Standard, the reference of which will be published in the Official Journal of the European Communities referencing the Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility (the "EMC Directive" 89/336/EEC [3] as amended).

Technical specifications relevant to the EMC Directive are given in annex A.

Definitions of paging equipment within the scope of the present document are given in annex B.

The present document is based upon the Generic Standards EN 50081-1 [1] and EN 50082-1 [2] and other standards, where appropriate, to meet the essential requirements of Council Directive 89/336/EEC [3].

For equipment which can be connected to the AC main supply, the requirements of EN 61000-3-2 [21] and EN 61000-3-3 [22] apply where appropriate from 2001-1-1.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	36 months after doa

1 Scope

The present document covers the assessment of paging equipment (receivers, transmitters and combined equipment) and associated ancillary equipment, in respect of ElectroMagnetic Compatibility (EMC). Technical specifications related to the antenna port and emissions from the enclosure port of paging equipment are not included in the present document. Such technical specifications are found in the relevant product standards for the effective use of the radio spectrum.

For paging equipment operated in wide-area paging services EMC-related technical specifications to the antenna port are found in the annex C of the present document.

The present document specifies the applicable EMC tests, the method of measurements, the limits and the minimum performance criteria for paging equipment and associated ancillary equipment as defined in annex B.

The environment classification used in the present document refers to the environment classification used in EN 50081-1 [1], and EN 50082-1 [2], except for the vehicular environment class which refers to ISO 7637 [12], [13].

The EMC requirements have been selected to ensure an adequate level of compatibility for apparatus at residential, commercial and light industrial environments. The levels, however, do not cover extreme cases, which may occur in any location but with low probability of occurrence.

The present document may not cover those cases where a potential source of interference which is producing individually repeated transient phenomena or a continuous phenomena is permanently present, e.g. a radar or broadcast site in the near vicinity. In such a case it may be necessary to use special protection applied to either the source of interference or the interfered part or both.

Compliance of paging equipment to the requirements of the present document does not signify compliance to any requirements related to spectrum management or to the use of the equipment (licensing requirements).

Compliance to the requirements of the present document does not signify compliance to any safety requirements. However, it is the responsibility of the assessor of the equipment to record in the test report any observations regarding the test sample becoming dangerous or unsafe as a result of the application of the tests called for in the present document.

The present document is based on the considerations and guidance given in ETR 238 [15].

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] EN 50081-1: "Electromagnetic compatibility - Generic emission standard - Part 1: Residential, commercial and light industry".

[2] EN 50082-1: "Electromagnetic compatibility - Generic immunity standard - Part 1: Residential, commercial and light industry".

[3] 89/336/EEC: "Council Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".

[4] EN 55022: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".

[5] CISPR 16-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

[6] EN 61000-4-2: "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".

[7] EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test".

[8] EN 61000-4-4: "Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test".

[9] EN 61000-4-5: "Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test".

[10] EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields".

[11] EN 61000-4-11: "Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests".

[12] ISO 7637-1 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage - Electrical transient conduction along supply lines only".

[13] ISO 7637-2 (1990): "Road vehicles - Electrical disturbance by conduction and coupling - Part 2: Commercial vehicles with nominal 24 V supply voltage - Electrical transient conduction along supply lines only".

[14] ETR 027 (1991): "Radio Equipment and Systems (RES); Methods of measurement for private mobile radio equipment".

[15] ETR 238: "ETSI/CENELEC standardization programme for the development of Harmonized Standards related to Electro-Magnetic Compatibility (EMC) in the field of telecommunications".

[16] ETS 300 133-4 (1997): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Enhanced Radio Messaging System (ERMES); Part 4: Air interface specification".

[17] ETS 300 133-5 (1997): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Enhanced Radio MEssage System (ERMES); Part 5: Receiver conformance specification".

[18] ETS 300 133-6 (1997): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Enhanced Radio MEssage System (ERMES); Part 6: Base station conformance specification".

[19] ETS 300 224 (1998): "Electromagnetic compatibility and Radio spectrum Matters (ERM); On-site paging service; Technical and functional characteristics for on-site paging systems, including test methods".

[20] ETS 300 719-1 (1997): "Radio Equipment and Systems (RES); Private wide area paging service; Part 1: Technical characteristics for private wide-area paging systems".

[21] EN 61000-3-2 (1995): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)".

[22] EN 61000-3-3 (1995): "Electromagnetic compatibility (EMC) - Part 3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A".

[23] Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

alignment range: frequency range over which the receiver or transmitter can be programmed and/or re-aligned to operate without any physical change of components other than programmable and frequency controlling devices

ancillary equipment: equipment (apparatus), used in connection with a receiver or transmitter, is considered as ancillary equipment (apparatus) if:

- the equipment is intended for use in conjunction with a receiver or transmitter to provide additional operational and/or control features to the paging equipment, (e.g. to extend control to another position or location); and
- the equipment cannot be used on a stand alone basis to provide user functions independently of a receiver or transmitter; and
- the receiver or transmitter to which it is connected, is capable of providing some intended operation such as transmitting and/or receiving without the ancillary equipment (i.e. it is not a sub-unit of the main equipment essential to the main equipment basic functions).

calling function: transmission of a message via the base transmitter to the paging receiver in order to alert and/or inform the carrier of the paging receiver

enclosure port: physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

integral antenna: antenna designed to be connected directly to the equipment with or without the use of an external connector and considered to be part of the equipment. An integral antenna may be fitted internally or externally to the equipment

mobile equipment: paging receiver or transmitter or combined receiver/transmitter (transceiver) capable of (also) being powered by the main battery of a vehicle for intended use

base receiver: receiver at a fixed location

pocket receiver: stand alone pocket paging receiver or a receiver being part of a pocket paging transceiver typically for portable use (portable equipment)

base transmitter: transmitter at a fixed location

pocket transmitter: stand alone pocket paging transmitter using the return channel, or a transmitter being part of a pocket paging transceiver typically for portable use (portable equipment)

port: particular interface, of the specified equipment (apparatus), with the electromagnetic environment (see figure 1)

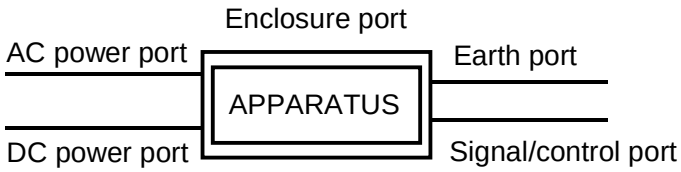


Figure 1: Examples of ports

portable equipment: paging receiver or transmitter or combined receiver/transmitter (transceiver) for portable use solely powered by built-in or external batteries

standby mode (receiver): standby mode of the paging receiver is the mode of operation in which the receiver is capable of receiving calls

standby mode (base transmitter): standby mode of the base transmitter is the mode of operation in which the transmitter is ready to transmit, waiting for a start control signal to actual start transmitting

standby mode (pocket transmitter): standby mode of the pocket transmitter is the mode of operation in which the transmitter is ready to transmit, waiting for a control signal to start the transmitting sequence

talk-back function: transmitting of a message from the pocket transmitter (normally combined in a transceiver) which is sent to a central receiver (base receiver) and further processed by the central processing unit

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
CR	Continuous phenomena applied to Receivers
CT	Continuous phenomena applied to Transmitters
DC	Direct Current
EMC	ElectroMagnetic Compatibility
ERMES	Enhanced Radio MEssage System
EUT	Equipment Under Test
erp	effective radiated power
IF	Intermediate Frequency
LISN	Line Impedance Stabilizing Networks
RF	Radio Frequency
rms	root mean square
TR	Transient phenomena applied to Receivers
TT	Transient phenomena applied to Transmitters
VSWR	Voltage Standing Wave Ratio

4 Test conditions

4.1 General

The equipment shall be tested under normal test conditions according to the relevant product and basic standards or to the information accompanying the equipment, which are within the manufacturers declared range of humidity, temperature and supply voltage. The test conditions shall be recorded in the test report.

The test configuration and mode of operation shall represent the normal intended use and shall be recorded in the test report.

For immunity tests the test modulation, test arrangements, etc., as specified in the present document, subclauses 4.1.1 to 4.8, shall apply and the conditions shall be as follows:

4.1.1 Receivers

Whenever a receiver is provided with a detachable antenna, the EUT shall be tested with the antenna fitted in a manner typical of normal intended use.

The individual immunity tests specified in clause 9 and its subclauses shall be performed with the receiver in the standby mode.

Mobile or pocket receivers:

- before the individual tests the receiver shall be set into the standby mode, a communications link shall be established and the message memory of the receiver shall be loaded with recognisable messages, if applicable (performance check);

- during the individual tests the wanted RF input signal is not applied to the receiver, except for the spot frequency test as part of the radio frequency electromagnetic field immunity test (subclause 9.2), where the receiver is provided with repetitive RF call signals;
- after the individual tests and the termination of the required performance assessment (e.g. by means of the stored messages in the message memory of the receiver, see subclauses 6.3 and 6.4) the communications link shall be re-established and another performance check shall be carried out to verify that the EUT is still operational.

Base receivers:

- base receivers are not subject to the spot frequency test as part of the radio frequency electromagnetic field immunity test;
- before the individual tests the base receiver shall be set into the standby mode, a communications link shall be established and the output of the receiver shall be monitored (performance check);
- during the individual tests the wanted RF input signal (the unmodulated carrier, see subclause 4.2) remains applied to the base receiver;
- after the individual tests of the base receiver (see subclauses 6.3 and 6.4) and the termination of the required performance assessment (e.g. by means of audio breakthrough measurements at the output of the base receiver, see subclauses 6.3 and 6.4) the maintained communications link is switched off and re-established to ensure that the base receiver is still able to receive new incoming requests.

4.1.2 Transmitters

The mobile or pocket transmitter is not subject to the spot frequency test as part of the radio frequency electromagnetic field immunity test.

The mobile or pocket transmitter shall operate in transmit mode with an unmodulated carrier, at its maximum rated output power. If unmodulated operation is not possible, the manufacturer shall specify the method of performance assessment and the acceptable degradation of performance.

The base transmitter shall operate in the standby mode, except for the spot frequency test as part of the radio frequency electromagnetic field immunity test (subclause 9.2), where the transmitter shall be tested additionally operated at its maximum rated output power, modulated with normal test modulation (subclause 4.2).

4.2 Normal test modulation

For mobile or pocket receivers the wanted RF input signal, if called for (see subclause 9.2), shall represent selective recognisable messages repeatedly transmitted to the EUT, and its frequency shall be set to the nominal frequency selected for the EUT.

For base receivers the wanted RF input signal shall be an unmodulated carrier, set to the nominal frequency selected for the EUT. If possible that unmodulated carrier also applies for the test of the talk-back function of the base receiver.

For mobile or pocket transmitters not having a modulation input port the internal equipment modulation shall be used as normal test modulation signal, and a repetitive call possibility shall be available.

For base transmitters, the normal test modulation signal to be used for the calling function shall represent selective messages and may be generated by a signal generator or encoded within the equipment. The signal generator used can be a test signal generator supplied by the manufacturer and capable of generating repetitive calls.

4.3 Arrangements for test signals at the input of receivers

The source of the wanted RF input signal as specified in subclause 4.2 shall be located outside the test environment. The level of the wanted RF input signal shall be chosen to a value significantly above the threshold sensitivity but below the overload characteristics of the receiver (the signal level should be 60 dB above the threshold sensitivity, if possible).

Where the receiver incorporates a RF antenna connector, the RF signal source shall be coupled to the input of the receiver via a shielded transmission line such as a coaxial cable. Where the receiver does not incorporate a RF

connector, the RF signal source shall be presented to the receiver from another antenna located within the test environment. This antenna shall be coupled to the RF signal source via an adjustable attenuator.

Adequate measures shall be taken to protect the measuring equipment from the effect of all radiated immunity test fields within the test environment.

For mobile or pocket receivers, the manufacturer shall at the time of submitting the equipment for testing, supply, if necessary, a test fixture and a message generator to generate the wanted RF input signal as requested in subclause 4.2, as appropriate.

4.4 Arrangements for test signals at the output of receivers

For mobile or pocket receivers, during the spot frequency test as part of the radio frequency immunity test (see subclause 9.2), the call received signal output of the receiver shall be coupled to the measuring equipment, located outside the test environment (e.g. by non-metallic means such as an acoustic tube/ coupler), and it shall be possible to assess the performance of the equipment from the call received signal(s) of the receiver.

For base receivers, the audio signal output of the receiver shall be coupled to the measuring equipment, located outside the test environment. When the receiver does not have an audio signal output, the manufacturer shall specify the method of performance assessment and the comparable degradation of performance.

Adequate measures shall be taken to protect the measuring equipment from the effect of all interference, e.g. radiated immunity test fields and conducted immunity test signals.

4.5 Arrangements for test signals at the input of transmitters

Mobile or pocket transmitters are normally not equipped with an external modulation input port, otherwise the arrangement for base transmitters shall apply here too.

For base transmitters, the signal generator to be used for the normal test modulation (see subclause 4.2) shall be located outside the test environment and connected to the modulation input port of the transmitter. Adequate measures shall be taken to protect the measuring equipment from the effect of all of the radiated immunity test fields within the test environment.

4.6 Arrangements for test signals at the output of transmitters

The measuring equipment used to monitor the output signal of the transmitter shall be located outside the test environment. Adequate measures shall be taken to protect the measuring equipment from the effect of all the radiated immunity test fields within the test environment.

Where the transmitter incorporates a RF antenna connector, the output signal of the transmitter shall be coupled to the measuring equipment via a shielded transmission line such as a coaxial cable. Where the transmitter does not incorporate an RF connector, the output signal of the transmitter shall be coupled to an antenna located within the test environment. This antenna shall be coupled by a shielded transmission line to the measuring equipment located outside of the test environment.

Pocket transmitters are subject to the spot frequency test as part of the radio frequency electromagnetic field immunity test (subclause 9.2). For this test the measuring equipment shall be a base receiver and the unmodulated RF carrier shall be transmitted and coupled to the input of the base receiver located outside the test environment.

Base transmitters are subject to the spot frequency test as part of the radio frequency electromagnetic field immunity test (subclause 9.2). For this test the measuring equipment shall be a paging receiver and repetitive calls shall be transmitted and coupled to the input of the paging receiver located outside the test environment.

4.7 Exclusion bands

Exclusion bands are determined frequency bands for which the Equipment Under Test (EUT) is excluded from RF emission and immunity tests.

4.7.1 Exclusion bands for receivers

The exclusion band for receivers (including receivers of pocket transceivers), is the frequency range determined by the alignment range, as declared by the manufacturer, extended as follows:

- for receivers operating in the frequency band 25 MHz to 80 MHz, the lower frequency of the exclusion band is the lower frequency of the alignment range minus 10 % of the centre frequency of the alignment range or minus 5 MHz, whichever results in the lower frequency. For such receivers the upper frequency of the exclusion band is the upper frequency of the alignment range plus 10 % of the centre frequency of the alignment range or plus 5 MHz, whichever is greater;

- for receivers operating above 80 MHz, the lower frequency of the exclusion band is the lower frequency of the alignment range minus 5 % of the centre frequency of the alignment range or 10 MHz, whichever results in the lower frequency, and the upper frequency of the exclusion band is the upper frequency of the alignment range plus 5 % of the centre frequency of the alignment range or plus 10 MHz, whichever is greater;

For ERMES receivers the exclusion band shall be the designated ERMES frequency band extended by 25 kHz in both directions (i.e. to lower and higher frequencies).

4.7.2 Exclusion band for transmitters

For transmitters operating, or intended to operate, in a channellized frequency band, the exclusion band is five times the channel spacing designated to the relevant paging service in the used frequency band, centred around the operating frequency.

4.8 Narrow band responses on receivers

No immunity tests shall be carried out on frequencies of identified unwanted narrowband responses (spurious responses) of the receiver. These narrowband responses (spurious responses) are identified by the following method.

If during the test the immunity test signal causes a non-acceptable degradation in performance (see subclause 6.3), it is necessary to establish whether this is due to a narrow band response or to a wideband phenomenon. Therefore, the unwanted signal frequency is increased by an amount equal to twice the nominal bandwidth of the IF filter immediately preceding the demodulator of the receiver, as declared by the manufacturer. The test is repeated with the frequency of the unwanted signal decreased by the same amount.

If the degradation in performance becomes acceptable again (see subclause 6.3), then the response is considered to be a narrow band response. If the degradation in performance is still not acceptable, this may be due to the fact that the offset has made the frequency of the unwanted signal correspond to the frequency of another narrow band response. Under these circumstances the procedure is repeated with the increase and decrease of the frequency of the unwanted signal adjusted two and a half times the bandwidth previously referred to.

If the degradation in performance remains not acceptable (see subclause 6.3), the phenomenon is considered wide band and therefore an EMC problem and the equipment fails the test.

5 Performance assessment

5.1 General

Each type of equipment shall fulfil the requirements of the present document on all frequencies over which it is intended to operate. However, the tests shall be performed on one sample of equipment on a frequency within the alignment range.

The manufacturer shall at the time of submission of the equipment for test, supply the following information which shall be recorded in the test report:

- the ancillary equipment to be combined with the radio paging equipment for testing;

- an exhaustive list of ports, classified as either AC power, DC power or signal/control including the maximum allowed length of cable connected thereto;
- the user control functions and stored data that are required for normal operation and the method to be used to assess whether these have been lost after EMC stress;
- the method to be used to verify that a communication link is established and maintained;
- the bandwidth of the IF filter immediately preceding the demodulator, if applicable;
- the operating frequency bands over which the equipment is intended to operate;
- the alignment range of the paging receiver;
- the optional features (versions) of the equipment and the actual version of the equipment that is (which are) submitted for test.

5.2 Standard paging equipment

For radio paging equipment of non-specialised nature or for radio paging equipment combined with an ancillary equipment, the normal test modulation, test arrangements, etc. as specified in clause 4 and its subclauses shall apply.

For mobile or pocket receivers, the performance assessment during immunity tests is based on unintentional behaviour of the equipment. It shall be possible from the performance check before and after the test to assess the performance of the receiver from the presented messages and/or the call received alert signal(s) of the receiver (see subclause 4.1.1). During the spot frequency immunity test the performance will be verified by the assessment of the successful transfer of paging calls, i.e. from the call received signal(s) of the receiver.

For base receivers, the performance assessment during immunity tests is based on the audio breakthrough level caused by the modulation of the immunity test RF source, measured by the audio test equipment with the unmodulated wanted RF carrier provided to the EUT.

For mobile or pocket transmitters, the performance assessment during immunity tests is based on the audio breakthrough level caused by the modulation of the immunity test RF source, measured by the test receiver with the EUT in transmit mode of operation.

For base transmitters, the performance assessment during immunity tests is based on unintentional behaviour of the equipment, except during the spot frequency immunity test where the performance shall be verified by the assessment of the successful transfer of paging calls, i.e. from the call received signal(s) to the test receiver.

5.3 Special equipment and stand alone tested ancillary equipment

For paging equipment of a specialised nature and/or ancillary equipment tested on a stand alone basis the manufacturer shall define the test method to determine the acceptable level of performance or degradation of performance during and/or after the test. Under these circumstances the manufacturer shall provide the following information also for inclusion in the test report:

- the primary functions of the EUT during and after EMC stress;
- the intended functions of the EUT which shall be in accordance with the documentation accompanying the equipment;
- the pass/fail criteria for the EUT;
- the method of observing a degradation of performance of the EUT.

The assessment of the performance or its degradation which is carried out during and/or after the tests, shall be simple, but at the same time give adequate proof that the primary functions of the equipment are operational.

5.4 Equipment classification

Paging equipment, or combinations of equipment declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as mobile equipment.

Paging equipment or combinations of equipment declared as being capable of being powered for intended use by AC mains shall additionally be considered as base station equipment for stationary use.

5.5 Ancillary equipment

At the manufacturer's discretion an ancillary equipment may be:

- assessed separately from the receiver or the transmitter against all applicable immunity and emission clauses of the present document;
- assessed applying another appropriate Harmonized EMC standard;
- assessed with it connected to a receiver or transmitter, in which case compliance shall be demonstrated to the appropriate clauses of the present document.

In each case, compliance enables the ancillary equipment to be used with different paging receivers or transmitters.

6 Performance criteria

The equipment shall meet the minimum performance criteria as specified in subclauses 6.1, 6.2, 6.3 and 6.4, as appropriate.

Paging equipment, for all immunity tests according to the present document, except the spot frequency test as part of the radio frequency immunity test (see subclause 9.2), shall be assessed for:

- the establishment of the communications link from the base transmitter to the mobile or pocket receiver, the transmission of recognisable messages and the detection and storage of these messages in the memory of the paging receiver before and after the test (performance check);
- where applicable, the establishment of the communications link from the mobile or pocket transmitter to the base receiver, the transmission of recognisable signals and the detection of these signals by the base receiver (performance check).

6.1 Performance criteria for Continuous phenomena applied to Transmitters (CT)

For mobile or pocket transmitters:

- a communications link shall be established before the test and during the test the modulation of the carrier caused by the modulation of the immunity test RF source shall be less then 25 % of the system peak modulation;
- during each individual exposure in the test sequence it shall be verified by appropriate means supplied by the manufacturer that the communication link is maintained;
- at the conclusion of the test the transmitter shall operate as intended with no loss of function;
- where the EUT is a stand alone transmitter, tests shall be repeated with the transmitter in standby mode to ensure that no unintentional transmission occurs.

For base transmitters:

- during the radio frequency immunity test (see subclause 9.2 and 9.5) no loss of functions or stored data shall occur. The transmitter output shall remain on channel and shall be unchanged from its initial power level;

- during the spot frequency test as part of the radio frequency immunity test (see subclause 9.2), the transmitter shall be capable of transmitting calls to a test receiver/measuring device with a resulting call acceptance ratio of 4:5 (four out of five) or better;
- at the conclusion of the test comprising the series of individual exposures the transmitter shall operate as intended with no loss of functions;
- during the tests in standby mode no unintentional transmission shall occur.

6.2 Performance criteria for Transient phenomena applied to Transmitters (TT)

For mobile or pocket transmitters:

- a one way communication link shall be established before the test and after each individual exposure it shall be verified, by appropriate means supplied by the manufacturer, that the communication link is maintained;
- at the conclusion of the test the EUT shall operate as intended with no loss of functions or stored data;
- where the EUT is a stand alone transmitter, tests shall be repeated with the transmitter in standby mode to ensure that no unintentional transmission occurs.

For base transmitters:

- the test shall be performed in standby mode, for all types of transmitters, to ensure that no unintentional transmission occurs;
- at the conclusion of the test the EUT shall operate as intended with no loss of functions or stored data.

6.3 Performance criteria for Continuous phenomena applied to Receivers (CR)

For mobile or pocket receivers:

- during the test no false call shall occur;
- at the conclusion of the test comprising the series of individual exposures the receiver shall operate as intended with no loss of functions or stored data (messages), as declared by the manufacturer (see subclause 5.1);
- during the spot frequency test as part of the radio frequency immunity test (subclause 9.2) the receiver shall provide a call received signal acceptance ratio of 4:5 (four out of five) or better;
- where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

For base receivers:

- a communications link shall be established before the test and during the test the audio output caused by the modulation of the immunity test RF source shall be less then 25 % of the system peak output voltage;
- during each individual exposure in the test sequence it shall be verified by appropriate means, supplied by the manufacturer, that the communication link is maintained;
- at the conclusion of the test, the receiver shall operate with no loss of function.

6.4 Performance criteria for Transient phenomena applied to Receivers (TR)

For mobile or pocket receivers:

- no false call shall occur due to the test;
- at the conclusion of the test, the receiver shall operate as intended with no loss of functions or stored data (messages), as declared by the manufacturer (see subclause 5.1);
- where the EUT is a transceiver, under no circumstances shall the transmitter operate unintentionally during the test.

For base receivers:

- a communication link shall be established before the test and after each individual exposure in the test sequence it shall be verified, by appropriate means, supplied by the manufacturer, that the communication link is maintained;
- at the conclusion of the test, the receiver shall operate with no loss of function.

7 Applicability overview table

7.1 Emission

Table 1: Emission measurements applicability

Pheno-menon	Application	Equipment test requirement			Reference subclause in the present document	Reference document
		Base station and ancillary equipment for fixed use	Mobile and ancillary equipment for vehicular use	Portable and ancillary equipment for portable use		
Radiated emission	Enclosure of ancillary equipment	applicable for stand alone testing	applicable for stand alone testing	applicable for stand alone testing	8.2	EN 55022 [4]
Conducted emission	DC power input/output port	applicable	applicable	not applicable	8.3	EN 55022 [4] CISPR 16-1 [5]
Conducted emission	AC mains input/output port	applicable	not applicable	not applicable	8.4	EN 55022 [4]
Harmonic current emissions	AC mains input port	applicable	not applicable	not applicable	8.5	EN 61000-3-2 [21]
Voltage fluctuations and flicker	AC mains input port	applicable	not applicable	not applicable	8.6	EN 61000-3-3 [22]

7.2 Immunity

Table 2: Immunity tests applicability

Phenomenon	Application	Equipment test requirement			Reference subclause in the present document	Reference document
		Base station and ancillary equipment for fixed use	Mobile and ancillary equipment for vehicular use	Portable and ancillary equipment for portable use		
RF electro-magnetic field (80 MHz to 1 000 MHz)	Enclosure	applicable	applicable	applicable	9.2	EN 61000-4-3 [7]
Electrostatic discharge	Enclosure	applicable	applicable	applicable	9.3	EN 61000-4-2 [6]
Fast transients common mode	Signal and control ports, DC and AC power input ports	applicable	not applicable	not applicable	9.4	EN 61000-4-4 [8]
RF common mode (current clamp injection) 0,15 MHz to 80 MHz	Signal and control ports, DC and AC power input ports	applicable	applicable	not applicable	9.5	EN 61000-4-6 [10]
Transient and surge	DC power input ports	not applicable	applicable	not applicable	9.6	ISO 7637-1 [12] ISO 7637-2 [13]
Voltage dips and interruption	AC mains power input ports	applicable	not applicable	not applicable	9.7	EN 61000-4-11 [11]
Surges, common and differential mode	AC mains power input ports	applicable	not applicable	not applicable	9.8	EN 61000-4-5 [9]

8 Methods of measurement and limits for EMC emissions

8.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses and are as follows:

- measurements shall be made in the operational mode producing the largest emission in the frequency band being investigated consistent with normal applications;
- the equipment shall be configured in a manner which is representative for normal/typical operation, where practical;
- an attempt shall be made to maximise the detected radiated emission, e.g. by moving the cables of the equipment;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment while connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;

- the configuration and mode of operation during the measurements shall be precisely noted in the test report.

8.2 Enclosure of ancillary equipment measured on a stand alone basis

This test is applicable to ancillary equipment not incorporated in the radio paging equipment and intended to be measured on a stand alone basis, as declared by the manufacturer. This test shall be performed on a representative configuration of the ancillary equipment.

8.2.1 Definition

This test assesses the ability of ancillary equipment to limit their internal noise from being radiated from the enclosure.

8.2.2 Test method

The test method shall be in accordance with EN 55022 [4].

8.2.3 Limits

The paging equipment shall meet the limits according to EN 55022 [4] (10 m measuring distance) shown in table 3.

Table 3: Limits for spurious radiations

Frequency range	Limit (Quasi-peak)
30 MHz to 230 MHz	30 dBµV/m
> 230 MHz to 1 000 MHz	37 dBµV/m

8.3 DC power input/output ports

This test is applicable for base station and ancillary equipment for fixed use that may have DC cables longer than 3 m.

If the DC power cable of the paging and/or the ancillary equipment is less than 3 m in length, and intended for direct connection to a dedicated AC/DC power supply, then the measurement shall be performed on the AC power input port of that power supply as specified in subclause 8.4. If the DC power cable may be longer than 3 m, then the measurement shall additionally be performed on the DC power port of the paging and/or ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

8.3.1 Definition

This test assesses the ability of transmitters, receivers, and ancillary equipment to limit their internal noise from being present on the DC power input/output ports.

8.3.2 Test method

For equipment with a current consumption below 16 A the test method shall be in accordance with EN 55022 [4] and the Line Impedance Stabilizing Networks (LISNs) shall be connected to a DC power source.

For equipment with a current above 16 A the DC power ports shall be connected to 5 µH Line Impedance Stabilizing Networks (LISNs), with 50 Ω characteristic measuring ports. The LISNs shall be in accordance with the requirements of clause 2 of CISPR 16-1 [5].

In the case of DC output ports the port shall be connected via a LISN to a load drawing the rated current of the source.

A measuring receiver shall be connected to each LISN measurement port in turn and the conducted emission shall be recorded. The LISN measurement ports not being used for measurement shall be terminated with a 50 Ω load. The equipment shall be installed with a ground plane as defined in EN 55022 [4]. The reference earth point of the LISNs shall be connected to the reference ground plane with a conductor as short as possible. The measurement receiver shall be in accordance with the requirements of section 1 of CISPR 16-1 [5].

8.3.3 Limits

The equipment shall meet the limits below including the average limit and the quasi-peak limit when using, respectively, an average detector receiver and a quasi-peak detector receiver and measured in accordance with the method described in subclause 8.3.2. If the average limit is met when using a quasi-peak detector, the equipment shall be deemed to meet both limits and measurement with the average detector is unnecessary.

The paging equipment shall meet the limits according to EN 55022 [4], shown in table 4.

Table 4: Limits for conducted RF signals

Frequency range	Quasi-peak	Average
0,15 MHz to 0,5 MHz	66 dBµV - 56 dBµV	56 dBµV - 46 dBµV
> 0,5 MHz to 5 MHz	56 dBµV	46 dBµV
> 5 MHz to 30 MHz	60 dBµV	50 dBµV
NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

8.4 AC mains power input/output ports

This test is applicable for base station and ancillary equipment for fixed use powered by the AC mains.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

8.4.1 Definition

This test assesses the ability of transmitters, receivers and ancillary equipment to limit its internal noise from being present on the AC mains power input/output ports.

8.4.2 Test method

The test method shall be in accordance with EN 55022 [4].

In the case of a AC output port the port shall be connected via a LISN to a load drawing the rated current of the source. In case where the AC output port is directly connected (or via a circuit breaker) to the AC power port of the EUT the AC power output port need not to be tested.

8.4.3 Limits

The paging equipment shall meet the limits according to EN 55022 [4] shown in table 4.

8.5 Harmonic current emissions (AC mains input port)

The requirements of EN 61000-3-2 [21] for harmonic current emission apply for equipment covered by the scope of this standard, as appropriate.

8.6 Voltage fluctuations and flicker (AC mains input port)

The requirements of EN 61000-3-3 [22] for voltage fluctuations and flicker apply for equipment covered by the scope of this standard, as appropriate.

9 Test methods and levels for immunity tests

9.1 Test configuration

This subclause defines the requirements for test configurations for tests in the following subclauses and are as follows:

- the tests shall be made in the mode(s) of operation as required in the subclauses 4.1.1 to 4.6;
- if the equipment is part of a system, or can be connected to ancillary equipment, then it shall be acceptable to test the equipment connected to the minimum representative configuration of ancillary equipment necessary to exercise the ports;
- for the immunity tests of ancillary equipment, without a separate pass/fail criteria, the receiver or transmitter coupled to the ancillary equipment, shall be used to judge whether the ancillary equipment passes or fails;
- if the equipment has a large number of ports, then a sufficient number shall be selected to simulate actual operational conditions and to ensure that all the different types of termination are covered;
- ports which in normal operation are connected, shall be connected to an ancillary equipment or to a representative piece of cable terminated to simulate the impedance of the ancillary equipment. RF input/output ports shall be correctly terminated;
- the configuration and mode of operation during the tests shall be precisely noted in the test report.

9.2 Radio frequency electromagnetic field (80 MHz to 1 000 MHz)

This test is applicable for base station, mobile, pocket and associated ancillary equipment.

Mobile or pocket transmitters and base receivers are, however, exempted from the spot frequency test.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.2.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic field disturbance.

9.2.2 Test method

The test method shall be in accordance with EN 61000-4-3 [7].

The following requirements and evaluation of test results shall apply:

- the test level shall be 3 V/m (measured unmodulated). The test signal then shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz;
- the test shall be performed over the frequency range 80 MHz to 1 000 MHz with the exception of the exclusion band for transmitters (see subclause 4.7.2) or with the exception of the exclusion band for receivers (see subclause 4.7.1), as appropriate;

- for receivers and transmitters, the stepped frequency increments shall be 1 % of the momentary frequency;
- the spot frequency test shall be performed at 80, 104, 136, 165, 200, 260, 330, 430, 560, 715 and 920 MHz ± 1 MHz, excluding those frequencies that fall within the exclusion band. The test shall additionally be performed at the edge frequencies of the exclusion band;
- responses on receivers occurring at discrete frequencies which are narrow band responses, shall be disregarded from the test (see subclause 4.8);
- the frequencies selected and used during the test shall be recorded in the test report.

9.2.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.1) shall apply.

For receivers the performance criteria CR (see subclause 6.3) shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

9.3 Electrostatic discharge

This test is applicable for base station, mobile, pocket and associated ancillary equipment.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.3.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of an electrostatic discharge.

9.3.2 Test method

The test method shall be in accordance with EN 61000-4-2 [6].

For transmitters, receivers, transceivers and ancillary equipment the following requirements and evaluation of test results shall apply.

The test severity level for contact discharge shall be 4 kV and for air discharge 8kV. All other details, including intermediate test levels, are contained within EN 61000-4-2 [6].

Electrostatic discharges shall be applied to all exposed surfaces of the EUT except where the user documentation specifically indicates a requirement for appropriate protective measures (EN 61000-4-2 [6]).

9.3.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.2) shall apply.

For receivers the performance criteria TR (see subclause 6.4) shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

9.4 Fast transients common mode

This test is applicable for base station and associated ancillary equipment for fixed use powered by the AC mains.

This test shall be performed on AC mains ports. This test shall be additionally performed on signal ports, control ports, and DC power ports if the cables may be longer than 3 m.

Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than 3 m, a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.4.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of fast transients present on one of the input/output ports.

9.4.2 Test method

The test method shall be in accordance with EN 61000-4-4 [8].

The following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be 0,5 kV open circuit voltage as given in EN 61000-4-4 [8];
- the test level for DC power input ports shall be 1 kV open circuit voltage as given EN 61000-4-4 [8];
- the test level for AC mains power input ports shall be 2 kV open circuit voltage as given EN 61000-4-4 [8].

For AC and DC power input ports the transients shall be applied (in parallel) to all the wires in the cable with reference to the cabinet reference ground (true common mode). The source impedance shall be 50 Ω.

9.4.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.2) shall apply.

For receivers the performance criteria TR (see subclause 6.4) shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria shall apply.

9.5 Radio frequency common mode (current clamp injection)

This test is applicable for base station and ancillary equipment for fixed use and for mobile and associated ancillary equipment.

This test shall be performed on AC mains power ports of base stations and ancillary equipment.

This test shall additionally be performed on signal, control, and DC power ports of base station and ancillary equipment, that can be connected to cables that are longer than 1 m.

This test shall additionally be performed on signal, control, and DC power ports of mobile and associated ancillary equipment, that can be connected to cables that are longer than 2 m.

Where this test is not carried out on any port because the manufacturer declares that it is not intended to be used with cables longer than 1 m (base station and ancillary equipment for fixed use), or 2 m (mobile and ancillary equipment), a list of ports which were not tested for this reason shall be included in the test report.

This test shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.5.1 Definition

This test assesses the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the presence of a radio frequency electromagnetic disturbance on the input/output ports. This test is considered to be a substitute for radiated radio frequency electromagnetic immunity testing in the frequency range 150 kHz to 80 MHz.

9.5.2 Test method

The test method shall be in accordance with EN 61000-4-6 [10].

The following requirements and evaluation of test results shall apply:

- the test signal shall be amplitude modulated to a depth of 80 % by a sinusoidal audio signal of 1 000 Hz;
- the test level shall be as defined in EN 61000-4-6 [10], equivalent to 3 V rms unmodulated, at a transfer impedance of 150 Ω;
- no intrusive or direct connection shall be made to any of the lines of any input/output port. Consequentially the clamp injection method shall be used;
- for receivers and transmitters the stepped frequency increments shall be 50 kHz in the frequency range 150 kHz to 5 MHz and 1 % frequency increment of the momentary frequency in the frequency range 5 MHz to 80 MHz;
- the test shall be performed over the frequency range 150 kHz to 80 MHz with the exception of the exclusion band for transmitters (see subclause 4.7.2) or with the exception of the exclusion band for receivers (see subclause 4.7.1) as appropriate;
- responses on receivers occurring at discrete frequencies which are narrow band responses, shall be disregarded from the test (see subclause 4.8);
- the frequencies selected during the test shall be recorded in the test report.

9.5.3 Performance criteria

For transmitters the performance criteria CT (see subclause 6.1) shall apply.

For receivers the performance criteria CR (see subclause 6.3) shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with receivers or transmitters in which case the corresponding performance criteria above shall apply.

9.6 Transients and surges in the vehicular environment

These tests are applicable to mobile and ancillary equipment intended for use in a vehicular environment.

These tests shall be performed on 12 V and 24 V DC power input ports of mobile and ancillary equipment, intended for mobile use in vehicles.

These tests shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.6.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of transients and surges present on their DC power input ports in a vehicular environment.

9.6.2 Test method

The test method shall be in accordance with ISO 7637-1 [12] for 12 V DC powered equipment and ISO 7637-2 [13] for 24 V DC powered equipment.

9.6.2.1 Test requirements for 12 V DC powered equipment

Where the manufacturer in his installation documentation requires the radio paging equipment to have a direct connection to the 12 V main vehicle battery the requirements in a) shall apply.

Where the manufacturer does not require the radio paging equipment to have a direct connection to the 12 V main vehicle battery the requirements in a) and b) shall apply:

a) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

   Pulse 4, level II, 5 pulses, with the characteristics as follows:

   V_s= -5 V; V_a= -2,5 V; t_6 = 25 ms; t_8 = 5 s; t_f = 5 ms;

b) Pulse 1, level II: t_1: 2,5 s; 10 pulses;

   Pulse 2, level II: t_1: 2,5 s; 10 pulses;

   Pulse 7, level II: 5 pulses.

Where the manufacturer declares that the paging equipment requires a direct connection to the main vehicle battery, and therefore the tests in accordance with the requirements b) are not carried out, this shall be stated in the test report.

9.6.2.2 Test requirements for 24 V DC powered equipment

Where the manufacturer in his installation documentation requires the paging equipment to have a direct connection to the 24 V main vehicle battery the requirements in c) shall apply.

Where the manufacturer does not require the paging equipment to have a direct connection to the 24 V main vehicle battery the requirements in c) and d) shall apply:

c) Pulse 3a and 3b, level II, with the test time reduced to 5 minutes for each;

   Pulse 4, level II, 5 pulses, with the characteristics as follows:

   V_s = -10 V; V_a = -5 V; t_6 = 25 ms; t_8 = 5 s; t_f = 5 ms;

d) Pulse 1a, level II: t_1 = 2,5 s; Ri = 25 Ω; 10 pulses;

   Pulse 1b, level II: t_1 = 2,5 s; Ri = 100 Ω; 10 pulses.

Where the manufacturer declares that the paging equipment requires a direct connection to the main vehicle battery, and therefore the tests in accordance with the requirements d) are not carried out, this shall be stated in the test report.

Radio and ancillary equipment designed to operate at both DC power voltages shall be tested in both configurations.

9.6.3 Performance criteria

For transmitters pulse 3a and 3b the performance criteria CT (see subclause 6.1) shall apply. For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria TT (see subclause 6.2) shall apply, with the exception that a communication link need not to be maintained during exposure and may have to be re-established.

For receivers pulse 3a and 3b the performance criteria CR (see subclause 6.3) shall apply. For pulse 1, 1a, 1b, 2, 4 and 7 the performance criteria TR (see subclause 6.4) shall apply, with the exception that a communication link need not to be maintained during exposure and may have to be re-established.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with receivers, transmitters or transceivers in which case the corresponding performance criteria above shall apply.

9.7 Voltage dips and interruptions

These test are applicable for base station and ancillary equipment for fixed use and powered by the AC mains.

These test shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.7.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of voltage dips and interruptions present on the AC mains power input ports.

9.7.2 Test method

The following requirements and evaluation of test results shall apply.

The test method shall be in accordance with EN 61000-4-11 [11].

The test levels shall be:

- a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms; and
- a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms; and
- a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms.

9.7.3 Performance criteria

For a voltage dip corresponding to a reduction of the supply voltage of 30 % for 10 ms the following performance criteria apply:

- for transmitters the performance criteria CT (see subclause 6.1);
- for receivers the performance criteria CR (see subclause 6.3);
- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

For a voltage dip corresponding to a reduction of the supply voltage of 60 % for 100 ms the following performance criteria apply:

- for transmitters the performance criteria TT (see subclause 6.2);
- for receivers the performance criteria TR (see subclause 6.4);
- for ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

For a voltage interruption corresponding to a reduction of the supply voltage of greater than 95 % for 5 000 ms the following performance criteria apply:

- in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria TT (see subclause 6.2) or TR (see subclause 6.4) apply as appropriate;
- in the case where the equipment is powered solely from the AC mains supply (without the use of a parallel battery back-up) volatile user data may have been lost and if applicable the communication link need not to be maintained and lost functions should be recoverable by user or operator;
- no unintentional responses shall occur at the end of the test;
- in the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded in the test report, the product description and the user documentation.

9.8 Surges, common and differential mode

These tests are applicable for base station and ancillary equipment for fixed use and powered by the AC mains.

These tests shall be performed on AC mains power input ports.

These tests shall be performed on a representative configuration of the radio equipment or a representative configuration of the combination of radio and ancillary equipment.

9.8.1 Definition

These tests assess the ability of transmitters, receivers, transceivers and ancillary equipment to operate as intended in the event of surges present on the AC mains power input ports.

9.8.2 Test method

The test method shall be in accordance with EN 61000-4-5 [9] except that the following requirements and evaluation of test results shall apply:

- the test level for signal and control ports shall be 0,5 kV line to ground as given in EN 61000-4-5 [9]. In this case the total output impedance of the surge generator shall be 42 Ω;
- the test level for ac mains power input ports shall be 1 kV line to ground and 0,5 kV line to line with the output impedance of the surge generator as given in the EN 61000-4-5 [9];
- the test generator shall provide the 1,2/50 µsec pulse as defined in EN 61000-4-5 [9].

9.8.3 Performance criteria

For transmitters the performance criteria TT (see subclause 6.2) shall apply.

For receivers the performance criteria TR (see subclause 6.4) shall apply.

For ancillary equipment the pass/failure criteria supplied by the manufacturer (see subclause 5.3) shall apply, unless the ancillary equipment is tested in connection with a receiver or transmitter in which case the corresponding performance criteria above shall apply.

Annex A (normative): Clauses and/or subclauses of the present document relevant for compliance with the essential requirements of EC Council Directives

Table A.1: Clauses and/or subclauses of the present document relevant for compliance with the essential requirements of EC Council Directives

Clause/subclause number and title		Corresponding article of Council Directive 89/336/EEC [3]	Qualifying remarks
8	Methods of measurement and limits for EMC emissions		
8.2	Enclosure	4 (a)	
8.3	DC power input/output ports	4 (a)	
8.4	AC mains power input/output ports	4 (a)	
8.5	Harmonic current emission (AC mains input port)	4 (a)	
8.6	Voltage fluctuations and flicker (AC mains input ports)	4 (a)	
C	Annex C; EMC requirements to the antenna port of wide-area paging equipment		
C.2	Spurious radiations of transmitters	4 (a)	
C.3	Spurious radiations of paging receivers	4 (a)	
9	Test methods and levels for immunity tests		
9.2	Radio frequency electromagnetic field (80 MHz - 1 000 MHz)	4 (b)	
9.3	Electrostatic discharge	4 (b)	
9.4	Fast transients common mode	4 (b)	
9.5	Radio frequency common mode (current clamp injection)	4 (b)	
9.6	Transients and surges in the vehicular environment	4 (b)	
9.7	Voltage dips and interruptions	4 (b)	
9.8	Surges, common and differential mode	4 (b)	
C	Annex C; EMC requirements to the antenna port of wide-area paging equipment		
C.4	Spurious response immunity	4 (b)	
C.5	Blocking immunity	4 (b)	

Annex B (normative): Definitions of the paging equipment in the scope of the present document

The present document covers the following types of radio paging equipment:

B.1 ERMES paging equipment

The present document applies to ERMES paging equipment and associated ancillary equipment operating in the ERMES Paging Service.

ERMES paging receivers are defined in ETS 300 133-5 [17].

ERMES paging transmitters are defined in ETS 300 133-6 [18].

B.2 On-site paging equipment

The present document applies to on-site paging equipment and associated ancillary equipment.

On-site paging equipment may comprise pocket receivers, pocket transmitters, pocket transceivers, and base transmitters or base receivers, as defined in ETS 300 224 [19], used in a privately owned and operated paging systems in a restricted and pre-defined area.

The radio-type of equipment operates in the frequency range 25 MHz to 470 MHz, and the loop-type of equipment operates in the frequency range 16 kHz to 146 kHz.

B.3 Wide-area paging equipment

The present document applies to wide-area paging equipment and associated ancillary equipment.

Wide-area paging equipment may comprise pocket receivers, base transmitters and associated ancillary equipment, as defined e.g. in ETS 300 719-1 [20] and is used in a privately owned and operated wide-area Paging Services as well as in public wide-area Paging Services.

The common EMC requirements to the antenna port of wide-area paging equipment are covered in the annexes C and D of the present document.

Annex C (normative): Requirements to the antenna port of wide-area paging equipment which are relevant for the compliance with the essential requirements of the EC Council Directive 89/336/EEC

C.1 Scope

This annex covers the EMC requirements to the antenna port of wide-area paging equipment. These requirements are considered to be: spurious emissions, spurious responses and blocking, and have been derived from consideration of the various National paging specifications used in Europe (see ETR 238 [15]).

EMC requirements to the antenna port of Private wide-area paging equipment are specified in the radio product standard ETS 300 719-1 [20].

C.2 Spurious radiations of wide-area paging transmitters

C.2.1 Definition

Spurious radiations are discrete radio frequency signals other than those of the wanted RF carrier and radiated out of band emissions associated with normal modulation.

The level of spurious radiations shall be measured as their power level into a specified load (conducted spurious components) and their effective radiated power when radiated by the cabinet and structure of the equipment (radiated spurious components).

C.2.2 Method of measurement

C.2.2.1 Method of measurement of conducted spurious components

Conducted spurious components shall be measured as the power level of any discrete signal delivered into a 50 Ω load. This may be done by connecting the transmitter output through an attenuator to a measuring receiver, or by monitoring the relative levels of the spurious signals delivered to an artificial load.

The transmitter shall be unmodulated if possible, and the measurements shall be made in the frequency range 9 kHz to 4 GHz except for the channel on which the transmitter is intended to operate and its adjacent channels.

If an unmodulated carrier can not be obtained, the measurement shall be made with the transmitter modulated by a paging test signal, in which case this fact shall be recorded in the test report. The measurement shall be made at the highest rated power level to which the transmitter can be set.

The measurement shall be repeated with the transmitter in the stand-by position.

C.2.2.2 Method of measuring radiated spurious components

On a test site, fulfilling the requirements of subclause C.3.4, the sample shall be placed at the specified height on the support. The transmitter shall be operated with maximum carrier output power as specified by the manufacturer, delivered to an artificial load.

The transmitter shall be unmodulated if possible, and the radiation of any spurious component shall be detected by the test antenna and receiver, over the frequency range 30 MHz - 4 GHz, except for the channel on which the transmitter is intended to operate and its adjacent channels.

If an unmodulated carrier cannot be obtained, the measurement shall be made with the transmitter modulated by a paging test signal, in which case this fact shall be recorded in the test report.

At each frequency at which a component is detected, the sample shall be rotated to obtain a maximum response and the effective radiated power (erp) of that component shall be determined by a substitution measurement.

The measurements shall be repeated with the test antenna in the orthogonal polarization plane.

The measurements shall be repeated with the transmitter in the stand-by mode of operation.

The bandwidth used in this measurement for each spurious radiation shall be sufficiently wide to accept all significant components of the spurious radiation concerned. The conditions used in the relevant measurements shall be recorded in the test report. It is assumed that a -6 dB bandwidth of 120 kHz is sufficiently wide and a correct value for this measurement.

C.2.3 Limits

The power of any spurious component, conducted or radiated, shall not exceed the values given in table C.1.

Table C.1: Limits for radiated and conducted spurious components

Transmitter mode of operation	Frequencies less than or equal to 1 000 MHz	Frequencies greater than 1 000 MHz
transmit	250 nW	1 µW
stand by	2 nW	20 nW

C.3 Spurious radiations of wide-area paging receivers

C.3.1 Definition

Spurious radiations are discrete radio frequency signals radiated by the receiver.

They are specified as the power level of any discrete signal measured by the measuring device within the specified frequency range.

C.3.2 Method of measurement

On a test site, fulfilling the requirements of subclause C.3.4, the sample shall be placed at the specified height on the support. The receiver shall be switched on.

The radiation of any spurious components shall be detected by the test antenna and receiver over the frequency range of 30 MHz to 4 GHz.

At each frequency at which a component is detected, the sample shall be rotated to obtain the maximum response and the effective radiated power of that component determined by a substitution measurement.

The measurements shall be repeated with the test antenna in the orthogonal plane.

C.3.3 Limits

The power of any spurious component shall not exceed:

- 2 nW in the range 30 MHz to 1 GHz; and
- 20 nW in the range 1 GHz to 4 GHz.

C.3.4 Test site and general arrangements for the measurement of radiated fields

Test sites shall be open air. The term "open air" should be understood from an electromagnetic point of view. Such a test site may be "outdoor" (really in open air) or alternatively "indoor" with walls and ceiling transparent to the radio waves at the frequencies considered. For these purposes, an anechoic room is considered "open air".

For guidance on test sites see ETR 027 [14], the relevant part of which is reproduced in annex D.

C.4 Spurious response immunity

C.4.1 Definition

The spurious response immunity of the paging receiver is the ability to discriminate between the wanted signal modulated by a paging test signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained. Unwanted signal frequencies shall be tested from 30 MHz to 1 GHz except for frequencies within the wanted frequency channel and the both adjacent channels.

Spurious response immunity is defined as the level of the unwanted signal for which the message acceptance ratio is 80 %.

C.4.2 Method of measurement

The test fixture shall meet the requirements of clause C.7.

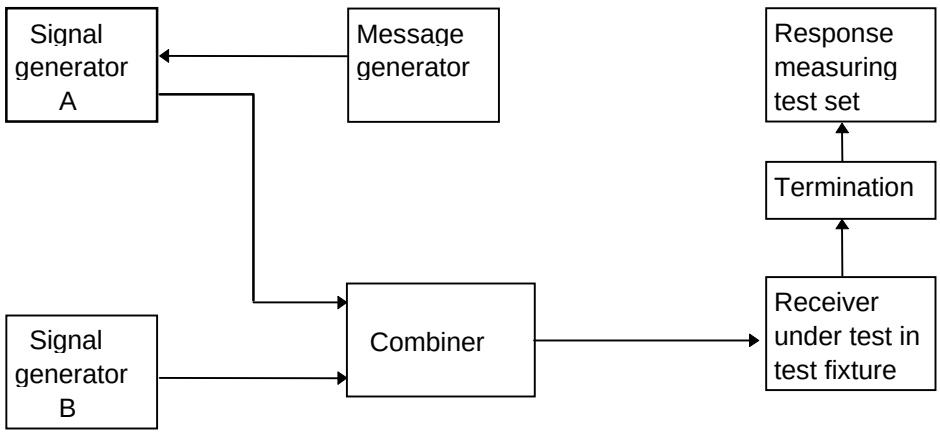


Figure C.1: Measuring arrangement

The method of measurement shall be as follows:

a) two signal generators, A and B shall be connected to the receiver via a combining network (see figure A.1). The wanted signal, produced by the signal generator A, shall be set to the carrier frequency and shall be modulated with normal test modulation (see subclause 4.2). The unwanted signal, produced by signal generator B, shall be modulated with a 400 Hz sinewave signal using a deviation equal to 12 % of the channel separation and shall be

adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur (see clause C.8);

b) initially, signal generator B shall be switched off. The level of signal generator A shall be adjusted to the reference level (see clause C.6);

c) the wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained;

d) the level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded;

e) the unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case, if a response is not obtained, the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded;

f) the measurement shall be repeated at each frequency within the specified frequency range at which it is calculated that a spurious response could occur (see clause C.8);

g) the spurious response immunity for messages for the frequency concerned is the ratio in dB of the average of the levels of the unwanted signal recorded in steps d) and e) to the level of the wanted signal, expressed in dB.

C.4.3 Limits

The spurious response immunity ratio shall not be less than 50,0 dB.

C.5 Blocking immunity

C.5.1 Definition

Blocking immunity for paging messages is a measure of the capability of the paging receiver to receive the wanted modulated signal at the nominal frequency without exceeding a given degradation due to the presence of an unwanted unmodulated high level input signal.

It is defined as the level of the unwanted signal for which the message acceptance ratio is 80 %. The wanted signal level shall correspond to the reference figure (see clause C.6).

C.5.2 Method of measurement

The test fixture shall meet the requirements of clause C.7.

The method of measurement shall be as follows:

a) two signal generators A and B shall be connected to the receiver input via a combining network (see figure C.1). The wanted signal, represented by signal generator A, shall be set to the carrier frequency and shall be modulated with normal test modulation (see subclause 4.2);

b) initially, the unwanted signal, represented by the signal generator B, shall be switched off and the amplitude of signal generator A shall be adjusted to the reference level (see clause C.6);

c) the wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The unwanted signal shall be unmodulated and its frequency shall be selected in the range + 1 MHz ± 10 % relative to the nominal frequency of the receiver. This frequency shall be one at which no spurious response has been

detected. The level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained;

d) the level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded;

e) the unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case, if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded;

f) the measurements shall be repeated for frequency of the unwanted signal selected in the range - 1 MHz ± 10 %, relative to the nominal frequency of the receiver;

g) the blocking level on either side of the carrier is taken as the average of the levels of the unwanted signal recorded in steps d) and e). The blocking level for messages shall be recorded as the ratio in dB of the lower value to the level of the wanted input signal.

C.5.3 Limits

The blocking level for messages shall not be less than 55,0 dB, except at frequencies on which spurious responses are found (see clause C.4).

C.6 Determination of reference level

The reference level is used as the basis for measurements in the appropriate test fixture. It shall be established according to the following procedure:

a) the receiver shall be placed into the test fixture (see figure C.2 and clause C.7) oriented as specified by the manufacturer;

b) the input signal level to the test fixture required to produce a message acceptance ratio of 80 % shall be determined and shall be noted in dBµV potential difference;

c) the reference level for this test fixture is then the value noted for step b), increased by +3 dB.

C.7 Description of test fixture

It is useful to have available a test fixture so that relative measurements can be readily carried out.

The test fixture shall be a radio frequency coupling device associated with an integral antenna equipment for coupling the integral antenna to a 50 Ω radio frequency terminal at the working frequencies of the equipment under test. This allows certain measurements to be performed using conducted measurement methods. This calibration may be achieved by the determination of the reference level as described in clause C.6.

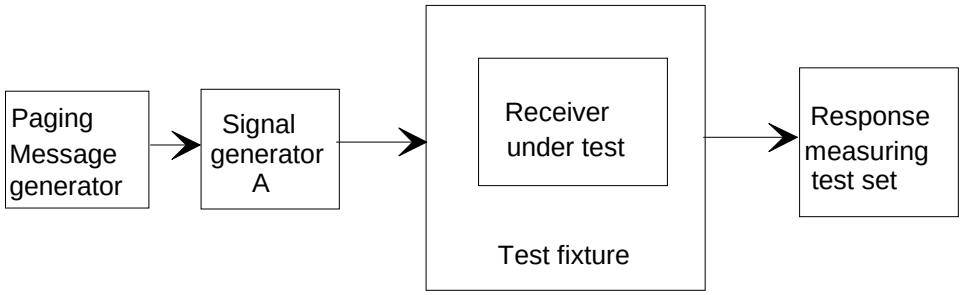


Figure C.2: Receiver in test fixture (see clause C.7)

In addition, the test fixture may provide:

1) a connection to an external power supply; and

2) interfaces to other relevant inputs and outputs.

The test fixture is normally provided by the applicant.

The performance characteristics of the test fixture shall be approved by the test laboratory and shall conform to the following basic parameters:

a) circuitry associated with the RF coupling shall contain no active or non linear devices;

b) the Voltage Standing Wave Ratio (VSWR) at the 50 Ω socket shall not be greater than 1,5 over the frequency range of the measurements;

c) the coupling loss shall be substantially independent of the position of the test fixture and be substantially unaffected by the proximity of surrounding objects or people. The coupling loss shall be reproducible when the equipment under test is removed and replaced;

d) the coupling loss shall remain substantially constant when the environmental conditions are varied.

C.8 Calculations of spurious responses frequencies

C.8.1 Introduction to the method

To determine the frequencies at which spurious responses may occur the following calculations shall be made:

a) calculation of the "limited frequency range":

- the limited frequency range is equal to the frequency of the local oscillator signal (f_{lo}) applied to the first mixer of the receiver ± the sum of the intermediate frequencies (if_1..if_n) and half the switching range of the receiver (sr/2);

- hence the limited frequency range is $f_{lo} \pm (if_1 + if_2 + ... + if_n + sr/2)$;

b) calculation of frequencies outside the limited frequency range:

- a calculation of the frequencies at which spurious responses can occur outside the range determined in a) shall be made for the remaining frequency range of interest;

- the frequencies outside the limited frequency range are equal to the harmonics of the frequency of the local oscillator signal (f_{lo}) applied to the first mixer of the receiver ± the numeric value of the first intermediate frequency (if_1) of the receiver;

- hence the frequencies of these spurious responses are $nf_{lo} \pm if_1$ where n is an integer greater than or equal to 2.

For the calculations a) and b) the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{lo}) applied to the first mixer of the receiver, the intermediate frequencies (if_1, if_2, etc.) and the switching range of the receiver.

NOTE: The switching range of the receiver is defined as the maximum frequency range over which the receiver can be operated without re-alignment or re-programming.

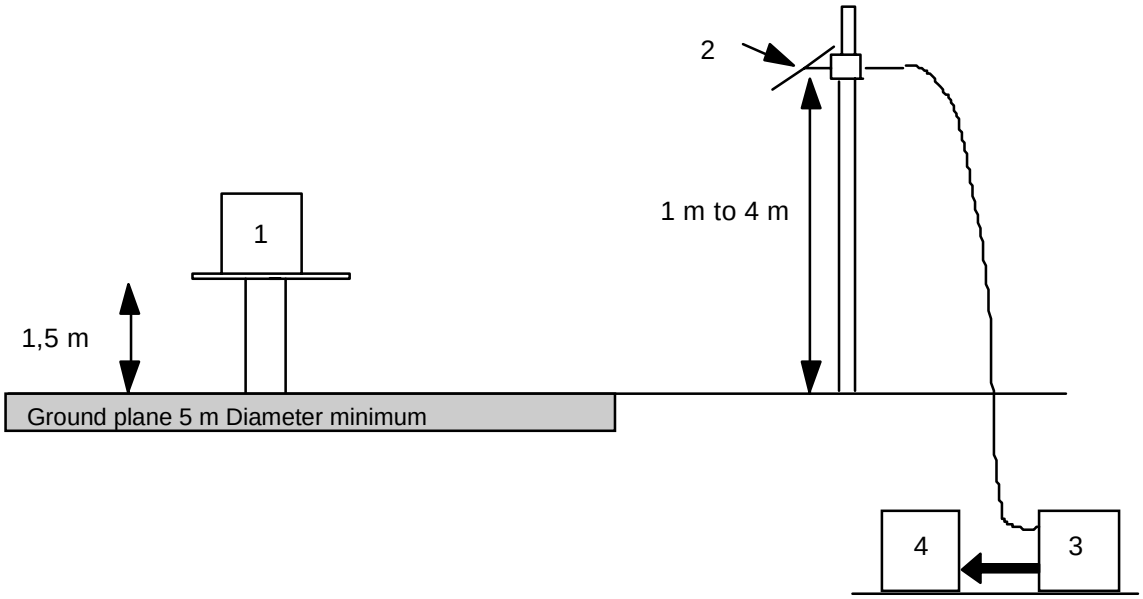
Annex D (normative): Measurement of radiated emissions

D.1 Test sites and general arrangements for measurements involving the use of radiated fields

D.1.1 Open air test site

The open air test site (see subclause A.3.4) shall be on a reasonably level surface or ground. At one point on the site, a ground plane of at least 5 m diameter shall be provided. In the middle of this ground plane, a non-conducting support, capable of rotation through 360° in the horizontal plane, shall be used to support the test sample in its standard position, at 1,5 m above the ground plane. The test site shall be large enough to allow the erection of a measuring or transmitting antenna at a distance of $\lambda/2$ or 3 m whichever is the greater. The distance actually used shall be recorded with the results of the tests carried out on the site.

Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site do not degrade the measurements results.



NOTE: 1) Equipment under test
2) Test antenna
3) High pass filter (may be necessary)
4) Spectrum analyser or measuring receiver

Figure D.1: Open air test site

D.1.1.1 Standard position

The standard position on all test sites, except for equipment which is intended to be worn on a person, shall be as follows:

- for equipment with an integral antenna; it shall be placed in the position closest to normal use as declared by the manufacturer;
- for equipment with a rigid external antenna; the antenna shall be vertical;

- for equipment with non-rigid external antenna, the antenna shall be extended vertically upwards by a non-conducting support.

D.1.2 Test antenna

The test antenna is used to detect the radiation from both the test sample and the substitution antenna, when the site is used for radiation measurements. Where necessary, it is used as a transmitting antenna, when the site is used for the measurement of receiver characteristics.

This antenna is mounted on a support such as to allow the antenna to be used in either horizontal or vertical polarization and for the height of its centre above ground to be varied over the range 1 m to 4 m. Preferably a test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

For receiver and transmitter radiation measurements, the test antenna is connected to a measuring receiver, capable of being tuned to any frequency under investigation and of measuring accurately the relative levels of signals at its input. For receiver radiated sensitivity measurements the test antenna is connected to a signal generator.

D.1.3 Substitution antenna

When measuring in the frequency range up to 1 GHz the substitution antenna shall be a $\lambda/2$ dipole, resonant at the operating frequency, or a shortened dipole, calibrated to the $\lambda/2$ dipole. When measuring in the frequency range above 4 GHz a horn radiator shall be used. For measurements between 1 GHz and 4 GHz either a $\lambda/2$ dipole or a horn radiator may be used. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet, or the point where an external antenna is connected to the cabinet.

The distance between the lower extremity of the dipole and the ground shall not be less than 0,3 m.

The substitution antenna shall be connected to a calibrated signal generator when the site is used for spurious radiation measurements and transmitter effective radiated power measurements. The substitution antenna shall be connected to a calibrated measuring receiver when the site is used for the measurement of receiver sensitivity.

The signal generator and the receiver shall operate at the frequencies under investigation and shall be connected to the antenna through suitable matching and balancing networks.

NOTE: The gain of a horn antenna is generally expressed relative to an isotropic radiator.

D.1.4 Optional additional indoor site

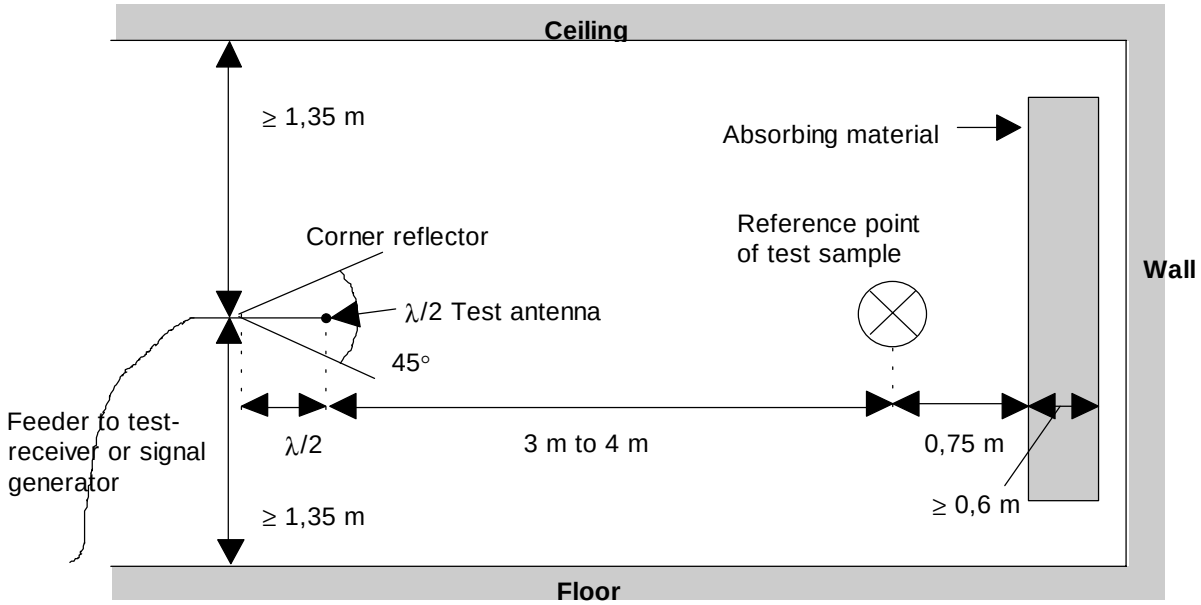


Figure D.2: Indoor test site arrangement (shown horizontal polarization)

When the frequency of the signals being measured is greater than 80 MHz, use may be made of an indoor test site. If this alternative site is used, this shall be recorded in the test report.

The measurement site may be a laboratory room with a minimum area of 6 m by 7 m and at least 2,7 m in height.

Apart from the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.

The potential reflections from the wall behind the equipment under test are reduced by placing a barrier of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling, in the case of horizontally polarized measurements. Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarized measurements. For the lower part of the frequency range (below approximately 175 MHz) no corner reflector or absorbent barrier is needed. For practical reasons, the $\lambda/2$ antenna in figure A.2 may be replaced by an antenna of constant length, provided that this length is between $\lambda/4$ and λ at the frequency of measurement, and the sensitivity of the measuring system is sufficient. In the same way the distance of $\lambda/2$ to the apex may be varied.

The test antenna, measuring receiver, substitution antenna and calibrated signal generator are used in a way similar to that of the general method. To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between the direct and the remaining reflected signals occurs, the substitution antenna shall be moved through a distance of ±0,1 m in the direction of the test antenna as well as in the two directions perpendicular to this first direction.

If these changes of distance cause a signal change of greater than 2 dB, the test sample should be re-sited until a change of less than 2 dB is obtained.

D.2 Guidance on the use of radiation test sites

For measurements involving the use of radiated fields, use may be made of a test site in conformity with the requirements of clause D.1 of this annex. When using such a test site, the following conditions should be observed to ensure consistency of measuring results.

D.2.1 Measuring distance

Evidence indicates that the measuring distance is not critical and does not significantly affect the measuring results, provided that the distance is not less than $\lambda/2$ at the frequency of measurement, and that the precautions described in this annex are observed. Measuring distances of 3 m, 5 m, 10 m and 30 m are in common use in European test laboratories.

D.2.2 Test antenna

Different types of test antenna may be used, since performing substitution measurements reduces the effect of the errors on the measuring results.

Height variation of the test antenna over a range of 1 m to 4 m is essential in order to find the point at which the radiation is a maximum.

Height variation of the test antenna may not be necessary at the lower frequencies below approximately 100 MHz.

D.2.3 Substitution antenna

Variations in the measuring results may occur with the use of different types of substitution antenna at the lower frequencies below approximately 80 MHz. Where a shortened dipole antenna is used at these frequencies, details of the type of antenna used should be included with the results of the tests carried out on the test site. Correction factors shall be taken into account when shortened dipole antennas are used.

D.2.4 Artificial antenna

The dimensions of the artificial antenna used during radiated measurements should be small in relation to the sample under test.

Where possible, a direct connection should be used between the artificial antenna and the test sample. In cases where it is necessary to use a connecting cable, precautions should be taken to reduce the radiation from this cable by, for example, the use of ferrite cores or double screened cables.

D.2.5 Auxiliary cables

The position of auxiliary cables (power supply and microphone cables, etc.) which are not adequately decoupled, may cause variations in the measurement results. In order to get reproducible results, cables and wires of auxiliaries should be arranged vertically downwards (through a hole in the non-conducting support).

D.3 Further optional alternative indoor test site using an anechoic chamber

For radiation measurements, when test frequency of the signals being measured is greater than 30 MHz, use may be made of an indoor test site being a well-shielded anechoic chamber simulating a free space environment. If such a chamber is used, this shall be recorded in the test report.

The test antenna, measuring receiver, substitution antenna and calibrated signal generator are used in a way similar to that of the general method, clause B.1. In the range 30 MHz to 100 MHz, some additional calibration may be necessary.

An example of a typical measurement site may be an electrically shielded anechoic chamber being 10 m long, 5 m broad and 5 m high. Walls and ceiling should be coated with RF absorbers of 1 m height. The base should be covered with absorbing material 1 m thick, and a wooden floor, able to carry test equipment and operators. A measuring distance of 3 m to 5 m in the long middle axis of the chamber can be used for measurements up to 12,75 GHz. The construction of the anechoic chamber is described in the following subclauses.

D.3.1 Example of the construction of a shielded anechoic chamber

Free-field measurements can be simulated in a shielded measuring chamber where the walls are coated with RF absorbers. Figure B.3 shows the requirements for shielding loss and wall return loss of such a room. As dimensions and characteristics of usual absorber materials are critical below 100 MHz (height of absorbers < 1 m, reflection attenuation < 20 dB) such a room is more suitable for measurements above 100 MHz. Figure B.4 shows the construction of an anechoic shielded measuring chamber having a base area of 5 m by 10 m and a height of 5 m.

Ceilings and walls are coated with pyramidal formed RF absorbers approximately 1 m high. The base is covered with absorbers which form a non-conducting sub-floor, or with special ground floor absorbers. The available internal dimensions of the room are 3 m × 8 m × 3 m, so that a maximum measuring distance of 5 m length in the middle axis of this room is available.

At 100 MHz the measuring distance can be extended up to a maximum of 2λ.

The floor absorbers reduce floor reflections so that the antenna height need not be changed and floor reflection influences need not be considered.

All measuring results can, therefore, be checked with simple calculations and the measurement uncertainties have the smallest possible values due to the simple measuring configuration.

D.3.2 Influence of parasitic reflections in anechoic chambers

For free-space propagation in the far field condition the correlation $E = Eo \times (Ro/R)$ is valid for the dependence of the field strength E on the distance R, whereby Eo is the reference field strength in the reference distance Ro.

It is useful to use this correlation for comparison measurements, as all constants are eliminated with the ratio and neither cable attenuation, nor antenna mismatch, or antenna dimensions are of importance.

Deviations from the ideal curve can be seen easily if the logarithm of the above equation is used, because the ideal correlation of field strength and distance can then be shown as a straight line and the deviations occurring in practice are clearly visible. This indirect method shows the disturbances due to reflections more readily and is far less problematical than the direct measurement of reflection attenuation.

With an anechoic chamber of the dimensions suggested in clause A.3 at low frequencies up to 100 MHz, there are no far field conditions and therefore reflections are stronger so that careful calibration is necessary. In the medium frequency range from 100 MHz to 1 GHz the dependence of the field strength on the distance meets the expectations very well. In the frequency range of 1 GHz to 12,75 GHz, because more reflections will occur, the dependence of the field strength on the distance will not correlate so closely.

D.3.3 Calibration of the shielded RF anechoic chamber

The calibration and mode of use is the same as for an open air test site, the only difference being that the test antenna does not need to be raised and lowered whilst searching for a maximum, which simplifies the method of measurement.

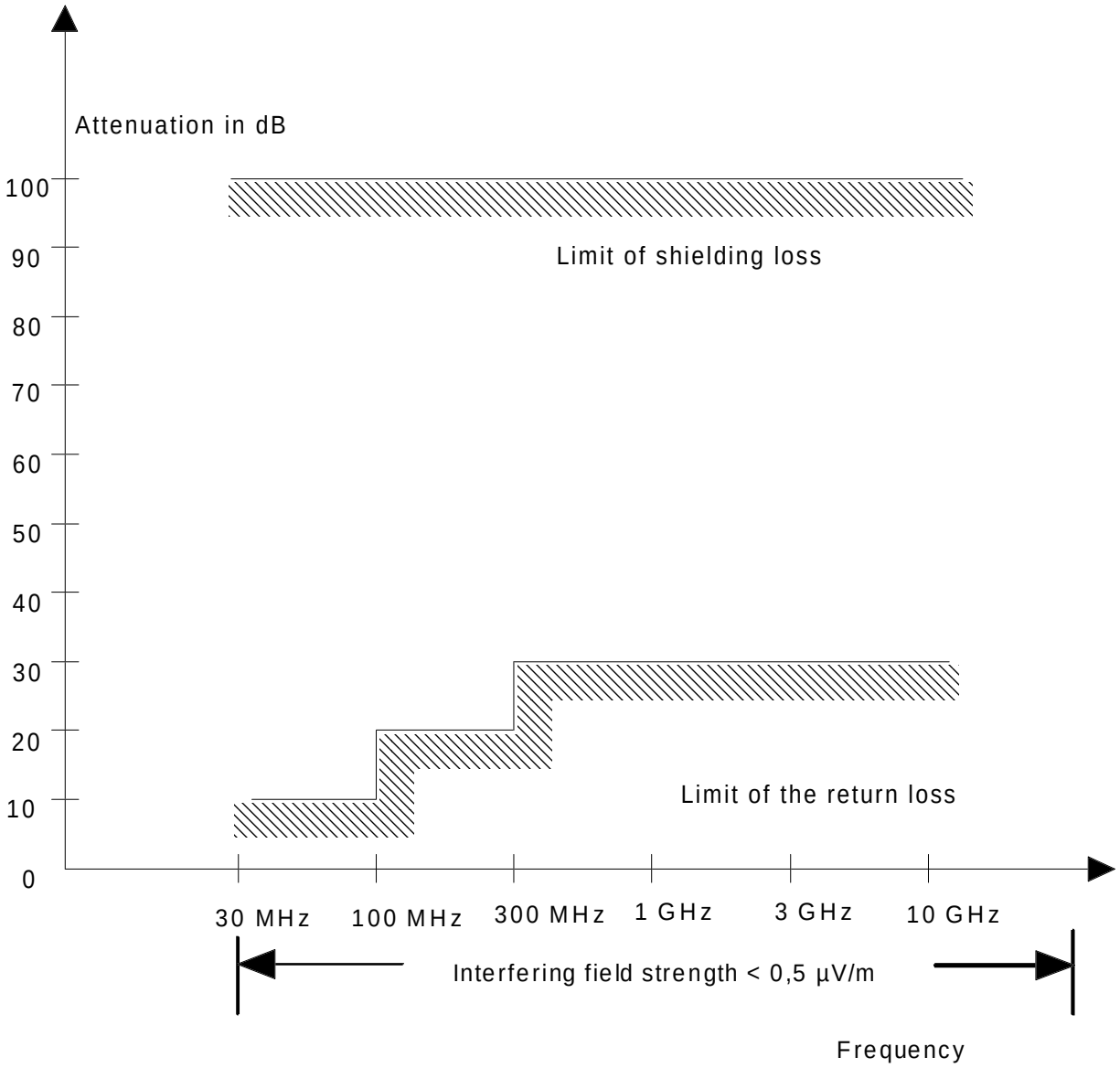

Attenuation in dB
100
90
80
70
60
50
40
30
20
10
0
Limit of shielding loss
Limit of the return loss
30 MHz
100 MHz
300 MHz
1 GHz
3 GHz
10 GHz
Interfering field strength < 0,5 µV/m
Frequency

Figure D.3

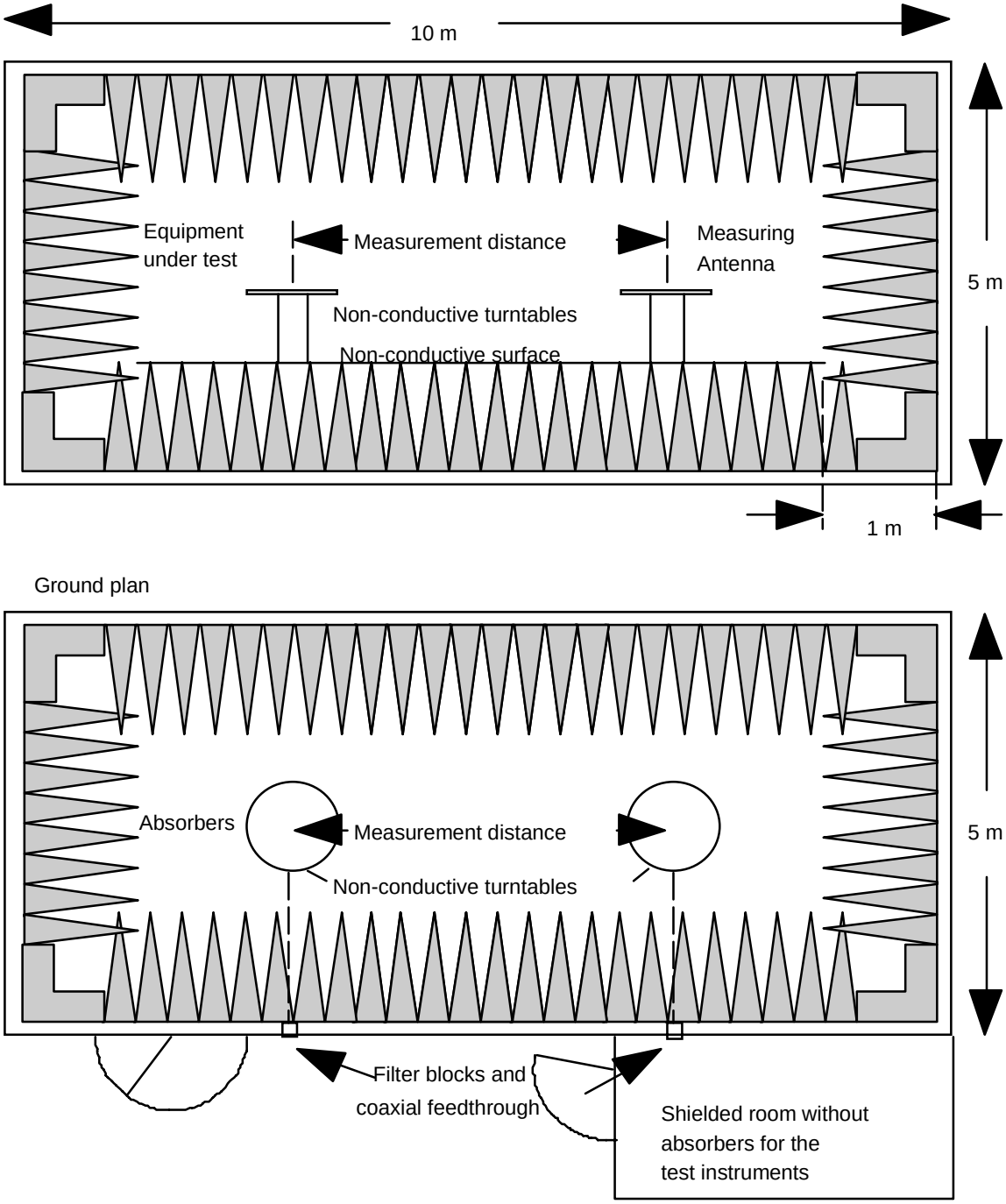


Figure D.4: Example of construction of an anechoic shielded chamber

History

Document history			
V1.1.1	July 1999	Public Enquiry	PE 9951: 1999-07-21 to 1999-11-19