

English version

**Alarm systems -
Intrusion systems**
**Part 5-3: Requirements for interconnections equipment
using radio frequency techniques**

Systemes d'alarme -
Systemes d'alarme intrusion
Partie 5-3: Exigences pour les équipements
d'alarme intrusion utilisant
des techniques radio

Alarmanlagen -
Einbruchmeldeanlagen
Teil 5-3: Anforderungen an
Übertragungsgeräte,
die Funkfrequenz-Techniken verwenden

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CENELEC

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Foreword

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1 Scope

This European Standard applies to intrusion alarm equipment using radio frequency (RF) links and located on protected premises. It does not cover long range radio transmissions.

This standard defines the terms used in the field of intrusion alarm equipment using radio frequency links as well as the requirements relevant to the equipment.

It shall be used in conjunction with the other parts of the EN 50131 series that define the functional requirements of the equipment regardless of the type of interconnections used.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| <u>Publication</u> | <u>Year</u> | <u>Title</u> |
|--------------------|-------------|---|
| EN 50131-1 | 1997 | Alarm systems – Intrusion systems – Part 1: General requirements |
| EN 50131-6 | 1997 | Alarm systems – Intrusion systems – Part 6: Power supplies |
| EN 301489-1 | 1999 | Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services – Part 1: Common technical requirements |

3 Definitions and abbreviations

For the purposes of this document, the following terms and definitions apply.

3.1 Definitions

3.1.1

alarm message

message conveying information regarding intruder, tamper or fault alarms

3.1.2

assigned band

frequency band within which the equipment is authorized to operate

3.1.3

attenuation

degradation of the RF signal due to a change in the passive environment of the system after its installation (e.g. creation, relocation or reflection or absorption materials)

3.1.4

collision

simultaneous transmissions from two or more RF communication devices belonging to the same system, of sufficient signal strength to cause corruption or obliteration of the RF signals

3.1.5

collision rate

probability of two or more messages having part or all of their information coincident on the RF link leading to a collision

3.1.6**communication link**

all local equipment, media and protocols used to route messages

3.1.7**disturbance**

event originating internally or externally to the system and liable to impair transmission and/or processing of data in the system

NOTE 1 It can be unintentionally or intentionally harmful.

Causes of disturbance are attenuation, collision, unintentional or intentional message substitution and other RF interference.

NOTE 2 The different effects which disturbances may have on the signals are

- no corruption of the RF signal,
- corruption of the RF signal with no message corruption,
- corruption of the RF signal with partial message corruption,
- total obliteration of the RF signal (inability to receive).

3.1.8**failure of periodic communication**

inability to pass a message on an RF link

3.1.9**identification code**

part of a message used to identify a transmitting RF communication device belonging to the system

3.1.10**intentional message substitution**

deliberate transmissions from an RF communication device using the correct protocol with the intention of reducing the security of the system

3.1.11**message authentication**

exchange of codes to validate the uniqueness of a transmitting device to a receiving device

3.1.12**monitoring message**

message used to check the integrity of the communication link

3.1.13**RF interference**

RF emissions from any other source, that may cause corruption or obliteration of wanted signals and do not conform to the definition of collision or message substitution

3.1.14**RF communication device**

device using RF transmission links

3.1.15**throughput ratio**

ratio of the total number of messages sent by the transmitting device to the total number of messages correctly interpreted by the receiving device

3.1.16

unintentional message substitution

non-deliberate transmissions from an RF communication device using the correct protocol emanating from another system with no intention of reducing the security

3.2 Abbreviations

For the purpose of this document, the following abbreviations apply:

ATE: alarm transmission equipment

CIE: control and indicating equipment

RF: radio frequency

RL: reference level

TL: transmitted level

WD: warning device

4 General requirements

4.1 Immunity to attenuation

Due to the fact there may be changes in the passive environment after installation, it shall be possible to temporarily attenuate the RF link during installation or maintenance according to the values given in Table 1.

The manufacturer shall specify the means used on its equipment to fulfil this requirement.

Table 1 – Immunity to attenuation

| | Attenuation |
|---------|--------------------|
| Grade 1 | 3 dB |
| Grade 2 | 6 dB |
| Grade 3 | 9 dB |
| Grade 4 | 12 dB |

NOTE Grades are defined in EN 50131-1.

4.2 Immunity to collision

4.2.1 Requirement for collision rate

The objective of the requirement for collision rate is to ensure a high level of confidence in the transmissions of alarm and monitoring messages thus reducing the probability of equipment on the same system causing interference by design and possibly leading to loss or corruption of information. To keep the collision rate as small as possible, the following requirements given in Table 2 shall be fulfilled.

Table 2 – Equipment occupation of the medium

| | Maximum occupation (percentage) | In a period of time of |
|---------|------------------------------------|------------------------|
| Grade 1 | 10 % | 240 min |
| Grade 2 | 10 % | 120 min |
| Grade 3 | 10 % | 100 s |
| Grade 4 | 10 % | 10 s |

In addition, all regulatory requirements concerning the duty cycle shall be complied with. To ensure successful transmissions for grade 3 and 4 equipment, all types of messages (i.e. alarm, monitoring, etc) shall be acknowledged by the receiving equipment to the transmitting equipment. In the case of one alarm message colliding with one monitoring message, the alarm information shall in any case be received in less than 10 s.

4.2.2 Requirement for throughput ratio

The objective of this requirement is to measure the ability of the receiving equipment to accurately interpret and execute correct alarm messages.

Receiving equipment shall comply with the requirements of Table 3.

Table 3 – Throughput ratio

| | Minimum number of correctly interpreted messages |
|---------|---|
| Grade 1 | 999 out of 1 000 |
| Grade 2 | 999 out of 1 000 |
| Grade 3 | 9 999 out of 10 000 |
| Grade 4 | 9 999 out of 10 000 |

4.3 Immunity to unintentional and intentional component and message substitution

Intentional message substitution generally attempts to reduce the security of the system primarily by falsely unsetting it. Unintentional message substitution generally causes false alarms or tamper alarms and has a nuisance value.

In order to prevent both unintentional and intentional message substitution, each transmitting device shall be identified as belonging to the system by an identification code. The number of identification code possibilities shall be at least equal to those shown in Table 4.

Table 4 – Identification codes

| | Identification codes |
|---------|----------------------|
| Grade 1 | 100 000 |
| Grade 2 | 1 000 000 |
| Grade 3 | 10 000 000 |
| Grade 4 | 100 000 000 |

4.3.1 Immunity to unintentional and intentional components substitution

For grade 4 equipment, the CIE shall have means to detect substitution.

4.3.2 Immunity to intentional message substitution

To decrease the risk of intentional message substitution, the equipment shall fulfil a requirement given by the probability for an intruder to discover the identification code in less than one hour. The requirements are shown in Table 5.

Table 5 – Message substitution

| | Probability lower than |
|---------|------------------------|
| Grade 1 | 5 % |
| Grade 2 | 1 % |
| Grade 3 | 0,5 % |
| Grade 4 | 0,05 % |

For grade 3 and grade 4 equipment, the receiving equipment shall have message authentication.

4.4 Immunity to interference

The purpose of this requirement is to check the ability of the receiving equipment to discriminate between the desired signal and the interfering RF signals.

This immunity to interference requirement applies to all RF receiving equipment. Each of the interference signals defined below shall be applied and shall not cause false alarms or an indication of a failure of periodic communication.

During continuous application of the interfering signals whose levels are defined in subsequent clauses, all of the 20 system relevant messages (sent by the transmitting equipment used for test purposes) shall be correctly received and processed by the receiving equipment.

4.4.1 Interference outside of the assigned band for grades 1 and 2 equipment

The receiving equipment shall be fully functional when the level of interference (defined as Level B in Annex C) is applied at frequency F_1 as stated in 4.4 and subsequently at frequency F_2 and according to the values of Table 6.

F_1 equals $(F_{\min} - 5\% F_{\min})$ where F_{\min} is the lowest frequency used by the equipment in the assigned band and F_2 $(F_{\max} + 5\% F_{\max})$ where F_{\max} is the highest frequency used by the equipment in the assigned band.

In the event of the receiving equipment operating in more than one assigned band, the requirement shall be fulfilled for each individual assigned band.

Table 6 – Interference outside of the assigned band for grades 1 and 2

| | F_1 Level B | F_2 Level B |
|---------|------------------|------------------|
| Grade 1 | 10 V/m | 10 V/m |
| Grade 2 | 10 V/m | 10 V/m |

4.4.2 Interference within the assigned band for grades 1 and 2 equipment

The receiving equipment shall be fully functional when the level of interference (defined as Level C in Annex C) is applied to a test frequency known as F_t and according to the values of Table 7:

- a) for receiving equipment using a single frequency known as F_w , F_t shall be equal to F_w ;
- b) for receiving equipment using two or more separate frequencies in the same assigned band, F_t shall be equal to $(F_{\min} + F_{\max}) / 2$, where F_{\min} is the lowest frequency used by the equipment and F_{\max} is the highest frequency used by the equipment in the assigned band;
- c) for receiving equipment using one or more separate frequencies in separate assigned bands, the test shall be conducted separately for each assigned band.

Table 7 – Interference within the assigned band for grades 1 and 2

| | F_t Level C |
|-------------------------------------|-------------------|
| Grade 1 | (Level A) – 12 dB |
| Grade 2 | (Level A) – 12 dB |
| NOTE Level A is defined in 5.1.6.2. | |

4.4.3 Interference for grades 3 and 4

The receiving equipment shall be fully functional when the level of interference (defined as Level D in Annex C) is applied separately at F_t , F_1 and finally F_2 , where F_t is as defined in 4.4.2, and F_1 and F_2 are as defined in 4.4.1 and according to the values given in Table 8.

Table 8 – Interference for grades 3 and 4

| | F_t Level D | F_1 Level D | F_2 Level D |
|---------|------------------|------------------|------------------|
| Grade 3 | 10 V/m | 10 V/m | 10 V/m |
| Grade 4 | 10 V/m | 10 V/m | 10 V/m |

4.5 Requirement for RF links monitoring

RF links monitoring shall be performed by all receiving equipment. The RF links shall be monitored in accordance with the grade. The indication or notification is dependent on the grade and the state of the equipment and the type of disturbances detected by the monitoring function.

The following disturbances shall be detected: failure of periodic communication and interference.

4.5.1 Requirement for the detection of a failure of periodic communication

The RF receiving equipment (CIE or ATE) shall report and identify a failure of periodic communication with a transmitting device of the system within the time periods specified in Table 9.

Table 9 – Periodic communication

| | By CIE from detector | By CIE from WD | By CIE from ATE | By ATE from CIE |
|---|-------------------------|----------------------|----------------------|--------------------|
| | Periods | | | |
| Grade 1 | 240 min | 240 min ^a | 240 min ^a | 240 min |
| Grade 2 | 120 min | 120 min ^a | 120 min ^a | 120 min |
| Grade 3 | 100 s | 100 s | 100 s | 100 s |
| Grade 4 | 10 s | 10 s | 10 s | 10 s |
| ^a This requirement is optional for this grade. | | | | |

In the event of a failure of periodic communication as defined in Table 9, a fault or tamper shall be generated for grades 1 and 2 equipment and a tamper shall be generated for grades 3 and 4 equipment.

In grades 1, 2, 3 and 4, setting shall be prevented when the last periodic communication message from any transmitting equipment exceeds the period specified in Table 10.

Table 10 – Periodic communication before setting

| | Period |
|---------|--------|
| Grade 1 | 60 min |
| Grade 2 | 20 min |
| Grade 3 | 100 s |
| Grade 4 | 10 s |

Portable equipment need not conform to the requirements given in Table 9 and Table 10.

4.5.2 Requirement for the detection of interference

If the level of interference is great enough to corrupt the correct transmissions between equipment, detection of interference shall take place when the levels of interference are detected for time periods as specified in Table 11.

Table 11 – Detection of interference

| | Detection of interference (maximum) |
|---------|--|
| Grade 1 | Sum total of 30 s of interference signal in any 60 s |
| Grade 2 | Sum total of 30 s of interference signal in any 60 s |
| Grade 3 | Sum total of 10 s of interference signal in any 20 s |
| Grade 4 | Sum total of 10 s of interference signal in any 20 s |

For all grades, where the interference detected is less than 5 s in any period of 60 s, there shall be no indication or notification. For grade 1 and 2 equipment fulfilling the requirement of grade 3 and 4 equipment as defined in 4.4.3, it is permissible to have an indication or notification for a time between 5 s and the times specified in Table 11.

In the event of detection of interference as defined in Table 11, a fault or tamper shall be generated for grades 1 and 2 equipment and a tamper shall be generated for grades 3 and 4 equipment.

According to the grade of the system, the following requirements given in Table 12 for interference detection apply:

Table 12 – Detection of interference for equipment

| | System state | CIE | WD | ATE |
|---------|--------------|---------------------------|-----------------------|-----------|
| | | Detection of interference | | |
| Grade 1 | At all times | Mandatory | Optional ^a | Optional |
| Grade 2 | At all times | Mandatory | Optional ^a | Optional |
| Grade 3 | At all times | Mandatory | Mandatory | Mandatory |
| Grade 4 | At all times | Mandatory | Mandatory | Mandatory |

^a For external devices, if this function is provided, the WD shall conform to the requirement for immunity to interference as defined in 4.4.3.

The interference signal (described as Level E in Annex C) shall be applied as shown in Annex B as defined in 5.1.7.2 according to the values of Table 13:

Table 13 – Level of interference signal

| | WD or ATE Tamper notification Level E |
|---------|---|
| Grade 1 | IL + 40 dB ^a |
| Grade 2 | IL + 30 dB |
| Grade 3 | IL + 9 dB |
| Grade 4 | IL + 9 dB |

NOTE IL is the interference level generated by the interfering transmitting equipment as defined in 5.1.7.2.

^a This requirement is optional.

4.6 Requirements for antennas

For grades 1 and 2, equipment using antennas external to the housing shall fulfil the requirements given in Table 14:

Table 14 – Requirements for antennas

| | Intentional degrading of antenna performance |
|-----|--|
| CIE | Indicate fault and prohibit setting |
| WD | Local notification by device |
| ATE | Automatic transmission of tamper alarm |

For grades 1 and 2 equipment, the antennas shall not be removable without opening the housing.

For grades 3 and 4 equipment, antennas shall fulfil the same tamper protection requirements as those of the device using these antennas.

5 Tests

5.1 RF disturbance tests

All level measurements shall be made with a spectrum analyser graduated in dBm unless otherwise stated. The RF level measured at the input of the spectrum analyser shall be equal to the RF signal level fed to the antennas. All cables shall have the same characteristic impedance.

For the tests, the manufacturer shall provide the receiving equipment to be tested, together with one or more devices modified to electronically trigger RF messages such as alarm, monitoring or other messages for test purposes or the transmitting equipment to be tested with associated receiving equipment, for test purposes.

If the equipment under test uses a primary battery power source only, no low battery indication shall be observed on completion of the test.

5.1.1 Reference level determination

The reference level of the receiving equipment under test shall be determined and used as a basis for other tests.

This measurement is to be conducted with the arrangement shown in Annex A, in a shielded anechoic chamber allowing tests to be carried out with a distance of 3 m between transmitting and receiving equipment.

The arrangement shown in Annex A shall be used, but the signal generator shall be replaced by a suitable load.

The RL level determination shall be performed twice, once with the antenna positioned horizontally and the once with the antenna positioned vertically. The smallest reference level indicates the position of the antenna to be used for all other tests.

The receiving equipment shall be oriented for maximum sensitivity.

To determine the reference level, the attenuation should be increased until 12 to 15 alarm messages out of 50 generated by the transmitting equipment are not received by the receiving equipment under test. The reference level is the value observed on the spectrum analyser measured in dBm increased by 3 dB.

EXAMPLE Value observed on the spectrum analyser is - 80 dBm.
Reference level is $RL = - 80 \text{ dBm} + 3 \text{ dB} = - 77 \text{ dBm}$.

5.1.2 Test for immunity to attenuation

The test method used to determine the reference level shall be used to check immunity to attenuation as specified in 4.1. For the purposes of this test, the equipment shall be configured as indicated in the manufacturer's installation or maintenance specification.

5.1.2.1 Measurement procedure of the transmitted level (TL) of the transmitting equipment

- a) The transmitting equipment under test shall be placed in the shielded anechoic chamber as shown in Annex D.
- b) Measure in dBm the TL of the transmitting equipment under normal conditions (TLn).
- c) Measure in dBm the TL of the transmitting equipment with the attenuation function active (TLi).

5.1.2.2 Measurement procedure of the reference level (RL) of the receiving equipment

- a) The receiving equipment under test shall be placed in the shielded anechoic chamber as shown in Annex A.
- b) Measure in dBm the RL of the receiving equipment under normal conditions (RL_n).
- c) Measure in dBm the RL of the receiving equipment with the attenuation function active (RL_i).

Verify the following result: [(TL_n - TL_i) - (RL_n - RL_i)] equals or greater to the values given in Table 1.

5.1.3 Verification of immunity to collision

The collision rate for any given system shall be calculated as a derivative of the maximum number of transmitters, duration of individual monitoring transmissions and number of monitoring transmissions.

The maximum number of transmitters to be considered for the calculation shall comply with the specification of the manufacturer. The manufacturer shall provide the information demonstrating how the system complies with the collision rate of Table 2.

Furthermore, transmitting equipment shall be triggered to transmit a monitoring message synchronously with the transmission of one alarm message. The CIE shall process the alarm in less than 10 s. The test shall be conducted in the anechoic chamber.

5.1.4 Test for throughput ratio

The test is to be conducted in a shielded anechoic chamber. The manufacturer shall provide the means for ensuring the transmission of the requisite number of alarm messages.

- a) The receiving equipment/transmitting equipment combination shall be configured to the reference level condition increased by 6 dB as determined in 5.1.1.
- b) A counter shall be connected to the transmitting equipment to record the number of transmissions. The arrangement shall not interfere with the transmitting equipment output.
- c) The transmitting equipment shall be capable of continuous transmission of 1 000 or 10 000 alarm messages with a valid identification code.

For all grades, if more than two alarm messages are lost, the equipment fails the test. If two alarm messages are lost, the test shall be repeated and no alarm message shall be lost.

5.1.5 Test for immunity to unintentional and intentional component and message substitution

According to Table 5, the manufacturer shall provide information demonstrating the method of compliance.

5.1.5.1 Test for immunity to component substitution for grades 3 and 4

The test shall be conducted in a shielded anechoic chamber. The CIE shall be in the set condition and placed in the shielded anechoic chamber in the arrangement shown in Annex A. The signal generator shall be replaced by a signal recorder and generator. An unset message shall be triggered by the original transmitter once, and this signal shall be recorded by the signal recorder. The CIE shall be set again. The signal recorder and generator shall be triggered continuously for one hour. The CIE shall remain set.

5.1.5.2 Test for immunity to message substitution

According to Table 5, the result shall be obtained using the method shown in Annex E.

According to the requirement of message authentication, the manufacturer shall provide information demonstrating the method of compliance.

5.1.6 Tests for immunity to interference

For high field strength measurements (above 1 V/m), a uniform field shall be first established in the shielded anechoic chamber.

All tests shall be performed twice, once with the antenna generating the interference signal positioned vertically and again with the antenna positioned horizontally.

5.1.6.1 Test for interference outside of the assigned band for grade 1 and 2 equipment

The equipment shall be arranged as shown in Annex B.

Before the interference signal is applied, the receiving equipment shall be set to the reference level condition. Attenuation shall now be reduced such that the observed signal level on the spectrum analyser is $RL + 20$ dB. This level is called Level A (see Annex C).

EXAMPLE (RL - 77 dBm, value to be observed equals $- 77$ dBm + 20 dB) = - 57 dBm)

An interference signal shall be applied continuously using the signal generator. This signal shall be 80 % amplitude modulated by the binary sequence "01010101". The modulation rate in baud is calculated according to the formula $R = 1/t$ where t is the shortest significant duration of the original transmitted signal.

The interference signal level (described as Level B in Table 6) shall be applied.

The test shall be conducted separately for frequency F_1 and frequency F_2 of each assigned band used by the receiving equipment and for both antenna polarities.

The test is satisfactory if the receiving equipment under test has correctly processed all of the 20 messages sent by the transmitting device used for test purposes.

5.1.6.2 Test for interference within the assigned band for grade 1 and 2 equipment

The equipment shall be arranged as shown in Annex B.

Before the interference signal is applied, the receiving equipment shall be set to the reference level condition. Attenuation shall now be reduced such that the observed signal level on the spectrum analyser is $RL + 20$ dB. This level is called Level A (see Annex C).

EXAMPLE (RL - 77 dBm, value to be observed equals $- 77$ dBm + 20 dB) = - 57 dBm)

An interference signal shall be applied continuously using the signal generator. This signal shall be 80 % amplitude modulated by the binary sequence "01010101". The modulation rate in baud is calculated according to the formula $R = 1/t$ where t is the shortest significant duration of the original transmitted signal.

The interference signal (described as Level C in Table 7) shall be applied.

The test shall be conducted for frequency F_1 of each assigned band used by the receiving equipment.

The test is satisfactory if the receiving equipment under test has correctly processed all of the 20 messages sent by the transmitting device used for test purposes.

5.1.6.3 Test for interference for grade 3 and grade 4 equipment

The equipment shall be arranged as shown in Annex B.

Before the interference signal is applied, the receiving equipment shall be set to the reference level condition. Attenuation shall now be reduced such that the observed signal level on the spectrum analyser is $RL + 20$ dB. This level is called Level A (see Annex C).

EXAMPLE (RL - 77 dBm, value to be observed equals - 77 dBm + 20 dB = - 57 dBm)

An interference signal shall be applied continuously using the signal generator. This signal shall be 80 % amplitude modulated by the binary sequence "01010101". The modulation rate in baud is calculated according to the formula $R = 1/t$ where t is the shortest significant duration of the original transmitted signal.

The interference signal level (described as Level B for outside of the band and Level D for inside of the band in Table 8) shall be applied.

The test shall be conducted separately for F_t , F_1 and F_2 of each assigned band used by the receiving equipment and for both antenna polarities.

The test is satisfactory if the receiving equipment under test has correctly processed all of the 20 messages sent by the transmitting device used for test purposes.

5.1.7 Tests for RF link monitoring

5.1.7.1 Tests for the detection of a failure of periodic communication on a link

Two different types of links may generate a failure of periodic communication:

- a) link between transmitting equipment and the CIE;
- b) link between the CIE and ATE.

This test shall be conducted in a shielded anechoic chamber as shown in Annex A.

The same test procedure shall be used for the following tests described in 5.1.7.1 a) and b). For each combination of equipment, the receiving equipment shall be configured in the reference level condition to receive signals from the transmitting equipment. It shall then be verified that monitoring signals are correctly received by the receiving equipment according to the specification provided by the manufacturer. The power supply of the transmitting equipment shall be disconnected to interrupt any transmissions or the transmissions shall be prevented.

The receiving equipment shall indicate or notify the failure of periodic communication in accordance with the times given in Table 9.

a) Supplementary test conditions for verifying links from a transmitting equipment to the CIE

- The test procedure defined in 5.1.7.1 shall be conducted with the CIE in the unset condition and a fault or a tamper shall be indicated as required.
- Furthermore for grades 2, 3 and 4 it shall be checked that the CIE is prevented from setting according to the times specified in Table 10.
- For grade 1 and 2 equipment, verify that the WD or the CIE indicates the link availability during the setting procedure.

b) Supplementary test conditions for verifying links from the CIE to an ATE

The test procedure defined in 5.1.7.1 shall be conducted with the CIE in the unset condition and a fault or a tamper shall be indicated by the ATE as required.

5.1.7.2 Tests for detection of interference

The receiving equipment under test shall be put to RF Level A condition as shown in Annex B, by using the standard transmitting equipment. The manufacturer shall provide modified transmitting equipment (named the interfering equipment) for test purposes which shall be capable of continuous transmission using the same transmission protocol as that used by the receiving equipment under test. This interfering equipment shall use a different identification code so that it shall not normally be recognized by the receiving equipment.

In addition, for equipment using more than one frequency, the interfering equipment shall allow a simultaneous transmission of all the frequencies used during the interference test or shall be fully synchronised on the frequency sequence of the standard transmitting equipment.

The equipment shall be arranged as shown in Annex G. The level of interference generated by the interfering transmitting equipment shall be increased until 5 or more alarm messages out of 20 generated by the standard transmitting equipment, are not received by the receiving equipment.

The interference level of the interfering equipment, measured on the spectrum analyser, is called Level II.

The transmission of the standard transmitting equipment shall be stopped and the interference level generated by the interfering equipment shall be increased by the values given in Table 13. Fault indication or tamper detection according to the type of equipment shall be verified.

The test is satisfactory when the following test sequences have been completed:

- a) application of interference signals up to 5 s shall not generate any notification or indication;
- b) application of interference signal for the values given in Table 13 shall generate a notification within the times specified in Table 11;
- c) the interference signals shall be applied in accordance with Annex F and using the times specified in Table 15.

Table 15 – Duration of interference signals

| | Sum of duration of signal(s) |
|---------|------------------------------|
| Grade 1 | 31 s |
| Grade 2 | 31 s |
| Grade 3 | 11 s |
| Grade 4 | 11 s |

5.2 Tests for antennas on grades 1 and 2 equipment

For each type of equipment defined in Table 14, configure the equipment in its normal condition. For fixed antennas, check that it is impossible to remove the antennas without opening the housing.

Where the antennas is external, cut the antennas at the point it leaves the housing by using cutting pliers and verify the requirements are achieved as defined in Table 14 in less than 10 s after antenna tamper.

5.3 Environmental tests

Equipment using RF links shall fulfil the environmental requirements defined in the relevant equipment standards.

Annex A
(normative)

Generic test arrangement for receiver

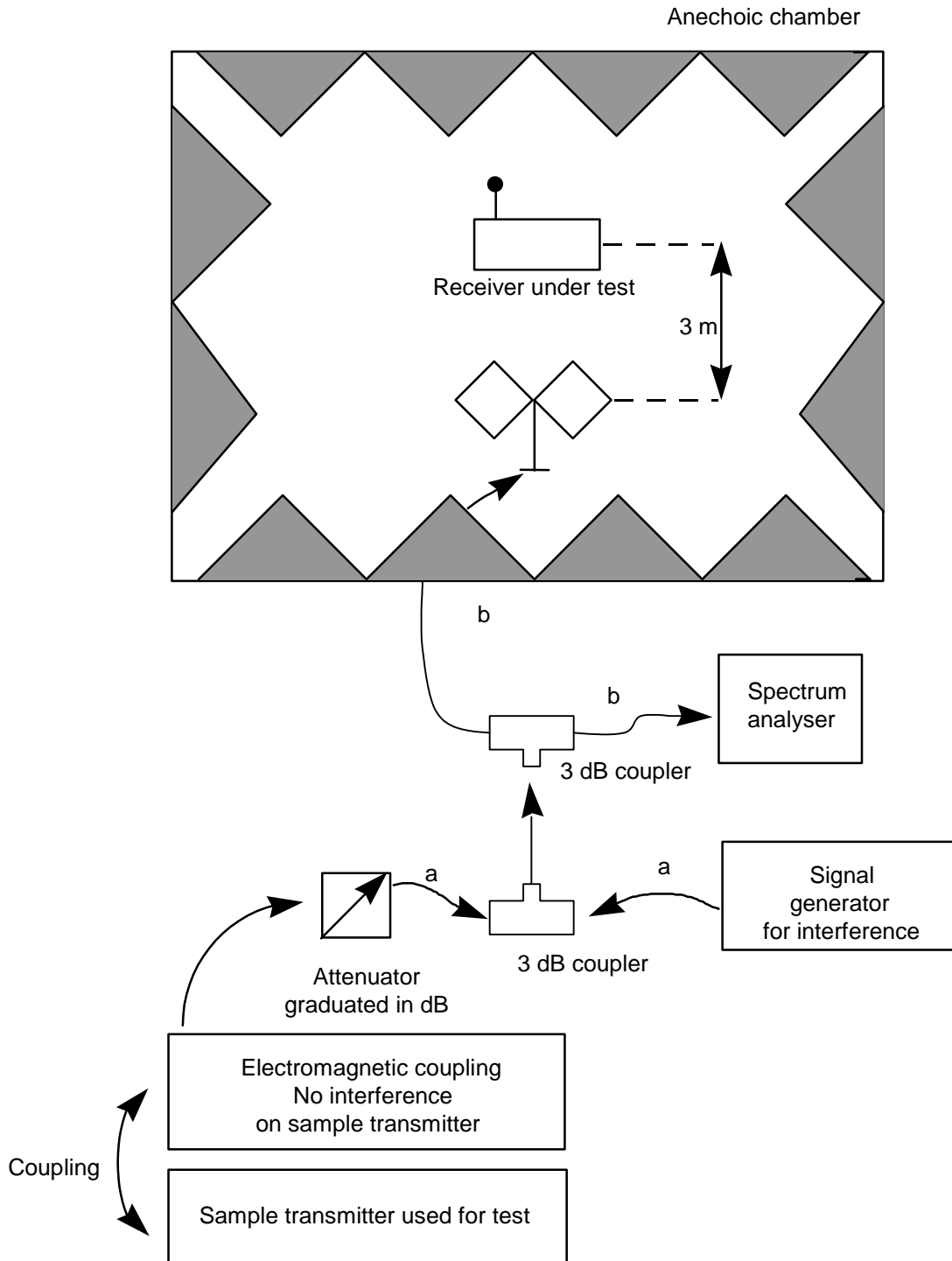


Figure A.1 – Generic test arrangement for receiver

Annex B (normative)

Test arrangement for interference tests

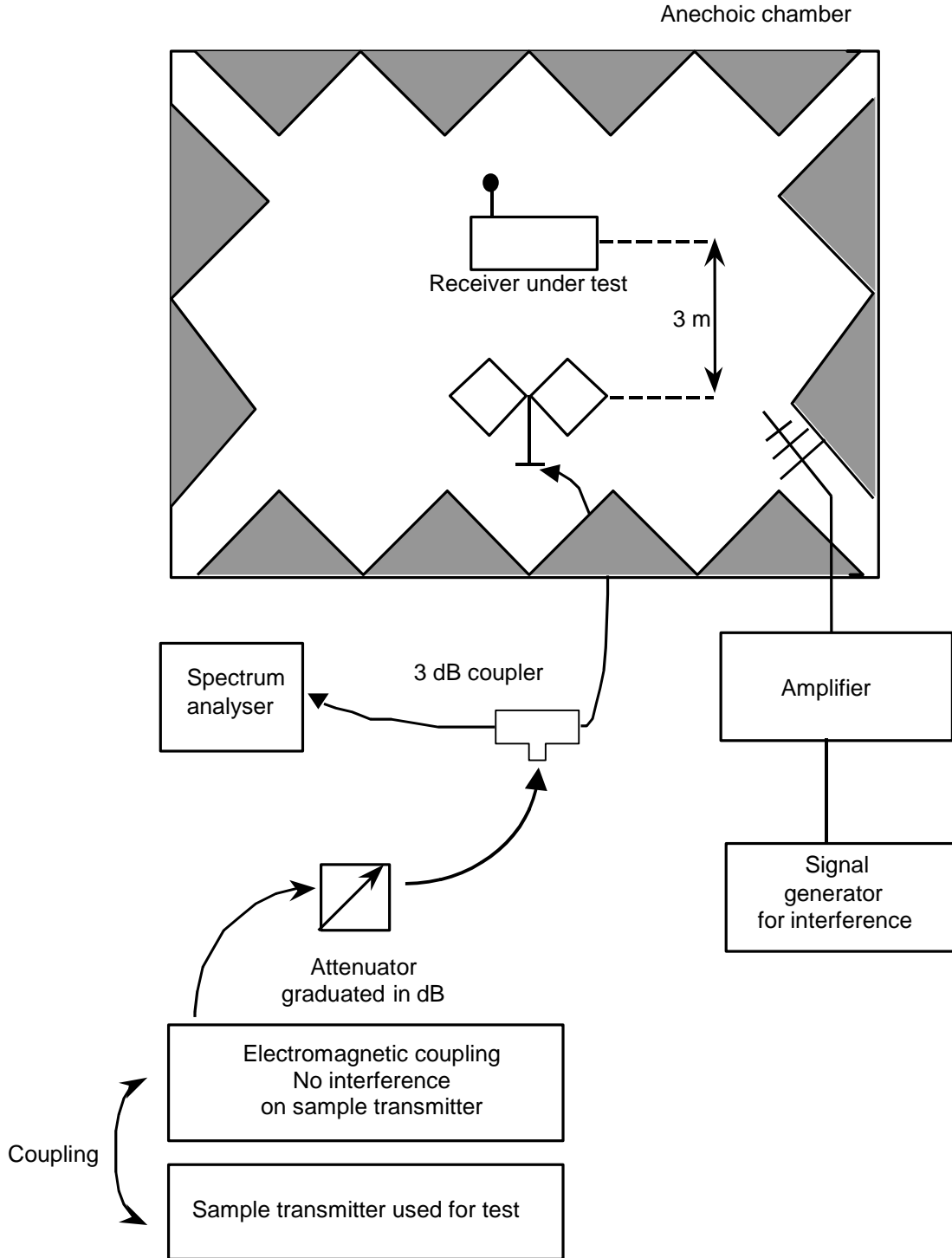


Figure B.1 – Test arrangement for interference tests

Annex C
(informative)

Signal levels diagram

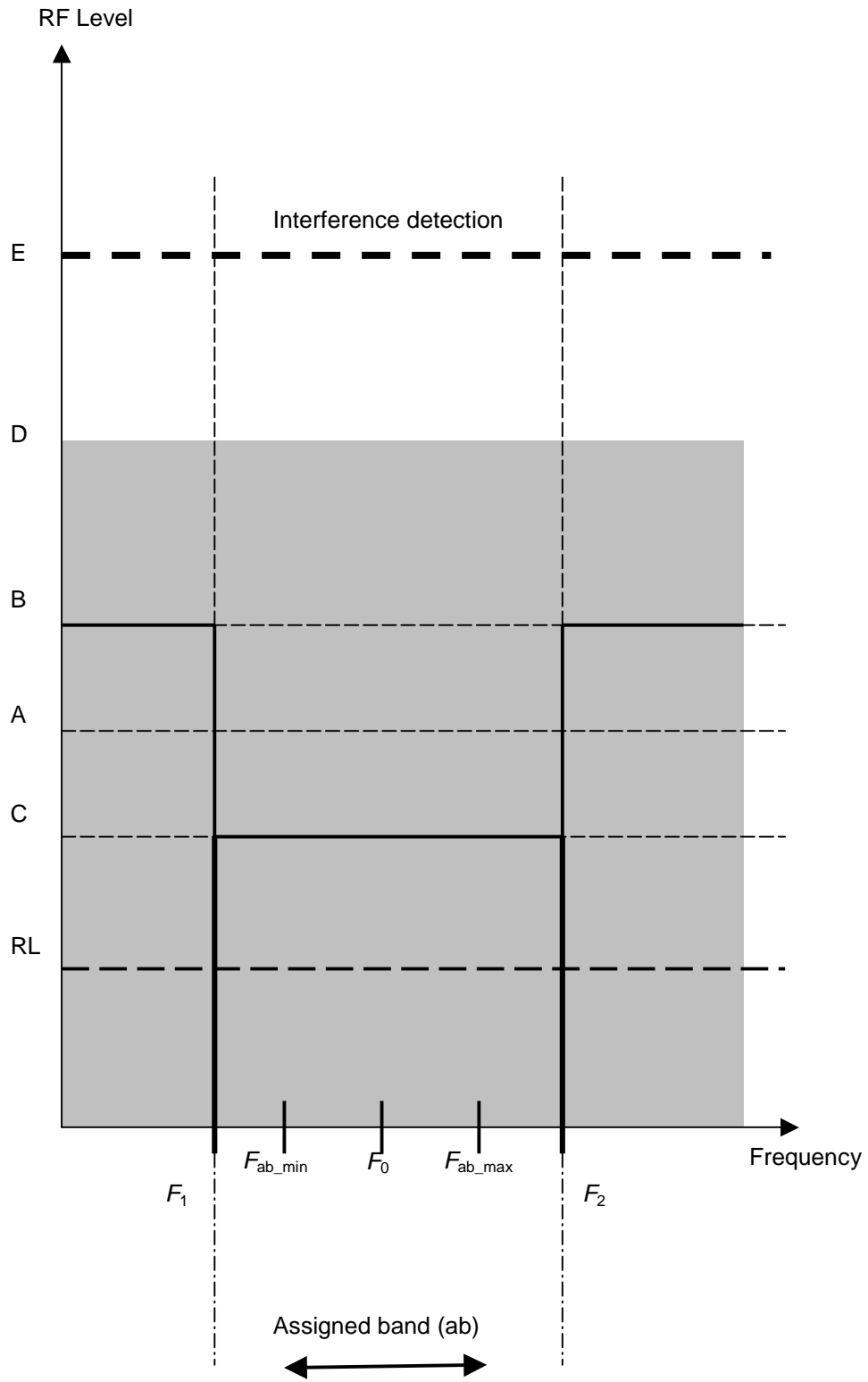


Figure C.1 – Signal levels diagram

Key

- RL: reference level
- Level A: RL + 20 dB
- Level B: level of interference outside ab for grades 1 and 2 equipment
- Level C: level of interference within ab for grades 1 and 2 equipment
- Level D: level of interference for grades 3 and 4 equipment
- Level E: level of interference detection
- F_0 : centre frequency of the assigned band
- F_{ab_min} : lower frequency of the assigned band
- F_{ab_max} : upper frequency of the assigned band
- $F_1 = F_{ab_min} - 5 \% F_{ab_min}$
- $F_2 = F_{ab_max} + 5 \% F_{ab_max}$
- ab: assigned band

Annex D
(normative)

Test arrangement for transmitter

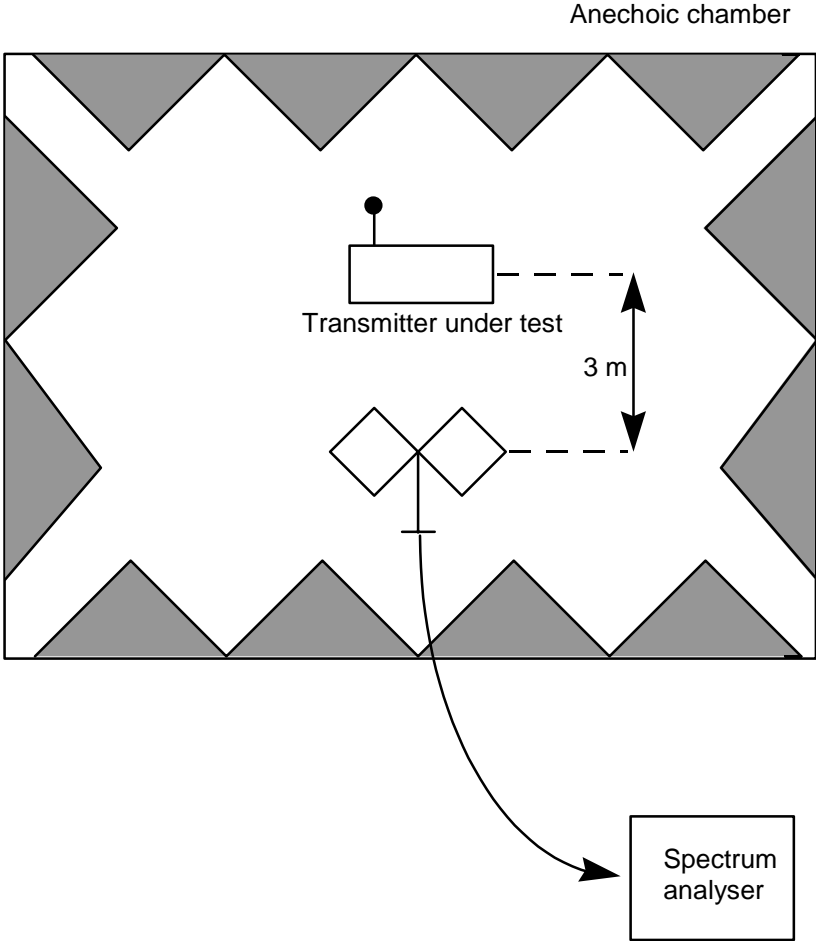


Figure D.1 – Test arrangement for transmitter

Annex E (normative)

Calculation for immunity to message substitution

Definitions

- If the identification code means are physically accessible, then N is the number of identification code possibilities.
- If the identification code means are not physically accessible, then N is the number of messages having the same length as the useful message.
- Let n be the number of equipment bearing different identification codes used to unset the system.
- Let τ be the maximum number of messages conveying different identification codes not belonging to the system received by the system in one hour.

The purpose of the following calculation is to determine the probability $P(n, \tau / N)$ of obtaining at least one of the identification codes of the unsetting equipment after τ attempts.

Then $P(n, \tau / N) = 1 - P_{\tau}$

Calculation of P_1 for one attempt: $P_1 = \frac{N-n}{N}$

Calculation of P_2 for two attempts: $P_2 = P_1 \times \frac{(N-1)-n}{(N-1)} = \frac{(N-n)(N-n-1)}{N(N-1)}$

Calculation of P_{τ} for τ attempts: $P_{\tau} = P_{\tau,1} \times \frac{N-(\tau-1)-n}{N-(\tau-1)}$

Hence $P_{\tau} = \frac{N-n}{N} \times \frac{N-n-1}{N-1} \times \dots \times \frac{N-n-(\tau-1)}{N-(\tau-1)} = \frac{(N-n)!}{N!} \times \frac{(N-\tau)!}{(N-n-\tau)!}$

Hence $P_{\tau} = 1 - \frac{C_{N-n}^{\tau}}{C_N^{\tau}}$ where $C_N^{\tau} = \frac{N!}{(N-\tau)!\tau!}$

Hence $P(n, \tau / N) = \frac{1 - C_{N-n}^{\tau}}{C_N^{\tau}}$

Hence $P(n, \tau / N) = \frac{C_N^{\tau} - C_{N-n}^{\tau}}{C_n^{\tau}}$

EXAMPLE:

$N = 10\,000$

$n = 4$

Assuming the system inhibits any unset command during 10 min after reception of 10 false unset commands.

Hence $\tau = 60$ (maximum number of attempts in one hour)

$$P(60,4/10\,000) = 1 - \frac{C_{9996}^{60}}{C_{10000}^{60}} = 2,38 \%$$

Annex F (normative)

Interference timing diagrams

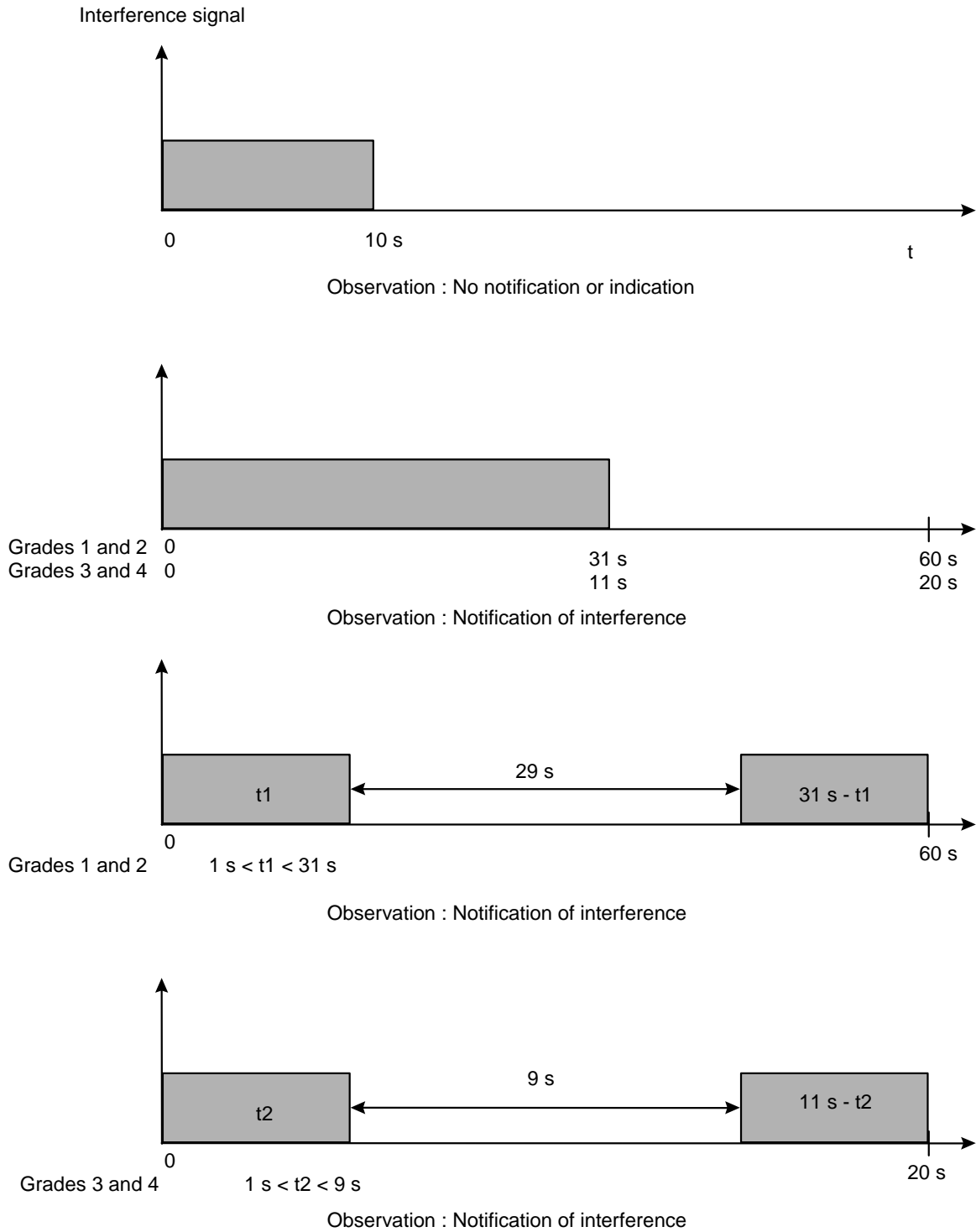


Figure F.1 – Interference timing diagrams

Annex G
(normative)

Test arrangement for detection of interference

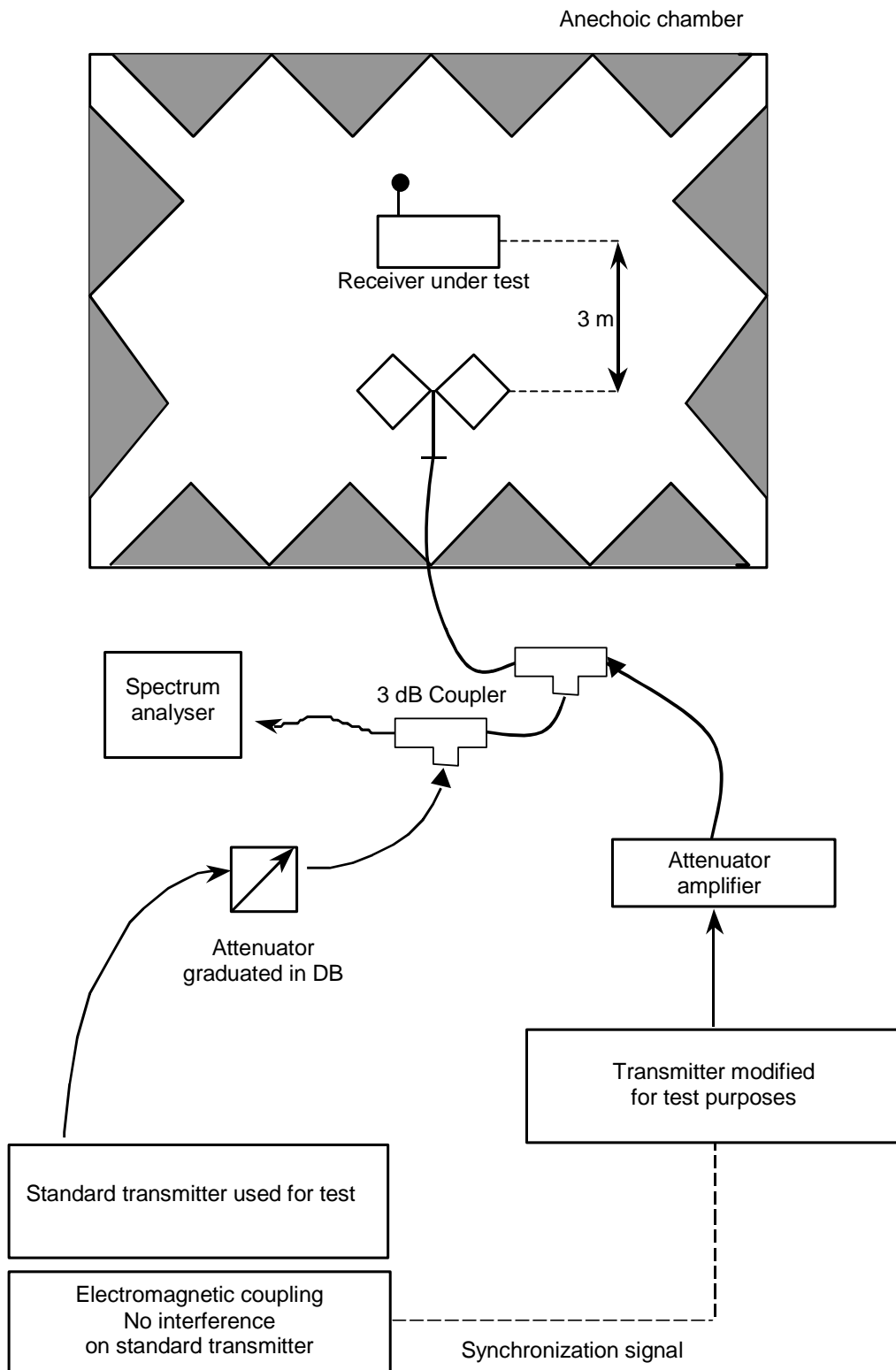


Figure G.1 – Test arrangement for detection of interference