

# EN 300 793 V1.1.1 (1998-02)

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*European Standard (Telecommunications series)*

## **Electromagnetic compatibility and Radio spectrum Matters (ERM); Land mobile service; Presentation of equipment for type testing**

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*European Telecommunications Standards Institute*

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**Reference**

DEN/ERM-RP02-024 (7cc00ico.PDF)

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**Keywords**

Mobile, radio, testing, type approval.

***ETSI Secretariat***

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**Postal address**

F-06921 Sophia Antipolis Cedex - FRANCE

---

**Office address**

650 Route des Lucioles - Sophia Antipolis  
Valbonne - FRANCE  
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  
Siret N° 348 623 562 00017 - NAF 742 C  
Association à but non lucratif enregistrée à la  
Sous-Préfecture de Grasse (06) N° 7803/88

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**Internet**

secretariat@etsi.fr  
<http://www.etsi.fr>

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## Foreword

This European Standard (Telecommunications series) has been produced by ETSI Technical committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is based upon RES-TR 003.

The present document is voluntary in application, however, it can be made mandatory, e.g. by National Administrations as a part of the conditions attached to the issue of type approval certificates for radio apparatus.

<b>National Transposition dates</b>	
Date of adoption of this EN:	23 January 1998
Date of latest announcement of this EN (doa):	31 May 1998
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 November 1998
Date of withdrawal of any conflicting National Standard (dow):	30 November 1998

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## Introduction

The present document is intended to provide guidance on the presentation of equipment for type testing, as stated in the scope. More specifically, it is expected that product standards for which (some of) the clauses of this standard are appropriate, will merely refer to the present document or to the applicable clauses of the present document (rather than copying the text of the appropriate clauses, in order to avoid having similar clauses in a number of different documents).

The material included in this standard is therefore intended for use by manufacturers (applicants), accredited testing laboratories and the appropriate administrations, to assess the number of samples that should be submitted for testing and so ensure that the performance of the equipment is representative of the performance of the corresponding production model.

The present document was drafted on the assumption that type test measurements performed in an accredited testing laboratory in one country would be accepted by the Administration in another country provided that the national regulatory requirements are met (in accordance to CEPT/ERC Recommendation T/R 01-06 [3]).

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# 1 Scope

The present document provides guidance on the presentation of equipment for type testing purposes. The present document covers, in particular:

- the choice of model for type testing;
- the number of equipment samples required;
- the number and range of tests required for each sample of submitted equipment.

Annex A gives examples of the number of tests that are required for different categories of equipment.

The types of equipment covered by the present document are as follows:

- base station (equipment fitted with an antenna socket, intended for use in a fixed location);
- mobile station (equipment fitted with an antenna socket, normally used in a vehicle or as a transportable);
- handportable stations (equipment having either an antenna socket, or an integral antenna).

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# 2 References

References may be made to:

- a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or
- b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or
- c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or
- d) publications without mention of a specific version, in which case the latest version applies.

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] ETS 300 086 (1991): "Radio Equipment and Systems (RES); Land mobile group; Technical characteristics and test conditions for radio equipment with an internal or external RF connector intended primarily for analogue speech".
- [2] ETS 300 341 (1995): "Radio Equipment and Systems (RES); Land mobile service; Technical characteristics and test conditions for radio equipment using an integral antenna transmitting signals to initiate a specific response in the receiver".
- [3] CEPT/ERC Recommendation T/R 01-06: "Procedures for type testing and approval for radio equipment intended for non public systems".

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# 3 Definitions and symbols

## 3.1 Definitions

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

**full tests:** The full range of tests as defined in the product standard(s) (e.g. ETS) to which measurements are being performed.

**limited tests:** The limited tests referred to in subclauses 4.1 to 4.13 are the limited tests as defined in the product standard(s) (e.g. ETS) to which measurements are being performed. Examples of the limited tests as defined in ETS 300 086 [1] and ETS 300 341 [2] are contained in annex B.

## 3.2 Symbols

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

AR	Alignment Range
AR <sub>0</sub> , AR <sub>1</sub> , ...	Category of alignment range (see subclauses 4.2.2 and 4.3)
FR <sub>C</sub>	Centre of frequency range (see table 1)
FR <sub>H</sub>	Higher end of frequency range (see table 1).
FR <sub>L</sub>	Lower end of frequency range (see table 1)
FT	Full Tests (see definition in subclause 3.1)
LT	Limited Tests (see definition in subclause 3.1)
OFR	Operating Frequency Range (see definition in subclause 4.2.3)
RF	Radio Frequency
SR	Switching Range (see definition in subclause 4.2.1)

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## 4 Presentation of equipment for testing purposes

Each equipment submitted for type testing shall fulfil the requirements of the product standard(s) to which measurements are to be performed, on all channels over which it is intended to operate.

The manufacturer should choose the appropriate frequencies for testing in consultation with the Administration(s) from whom type approval is sought and in accordance with subclauses 4.4 to 4.13 (see also annex A).

To simplify and harmonize the type testing procedures between the different testing laboratories, measurements shall be performed, according to the present document, on samples of equipment defined in subclauses 4.1 to 4.13, see also annex A.

These subclauses are intended to give confidence that the requirements set out in the product standard(s) to which measurements are to be performed have been met without the necessity of performing measurements on all channels.

### 4.1 Choice of model for type testing

The manufacturer shall provide one or more samples of the equipment, as appropriate, for type testing.

If an equipment has several optional features, considered not to affect the Radio Frequency (RF) parameters, then tests need only be performed on the equipment configured with that combination of features considered to be the most complex, as proposed by the manufacturer and agreed by the test laboratory.

In the case of hand portable equipment without a 50 Ω external antenna connector, see subclause 4.13.

## 4.2 Definitions of switching range, alignment range and operational frequency range

### 4.2.1 Definition of switching range

The manufacturer shall state the switching ranges of the receiver and the transmitter (which may differ).

The Switching Range (SR) is the maximum frequency range, as specified by the manufacturer, over which the receiver or the transmitter can be operated within the alignment range without reprogramming or realignment.

### 4.2.2 Definition of alignment range

The manufacturer shall also, when submitting equipment for type testing, state the alignment ranges for the receiver and the transmitter.

The Alignment Range (AR) is defined as the frequency range over which the receiver and/or the transmitter can be programmed and/or aligned to operate, without any change to the circuit other than the substitution of programmable read only memories or crystals (for the receiver and transmitter) and the trimming of discrete components.

Trimming is an act by which the value (in this case relating to frequency) of a component is changed within the circuit. This act may include the physical alteration, substitution (by components of similar size and type) or activation/de-activation (via the setting of soldered bridges) of components.

For the purpose of all measurements, the receiver and transmitter shall be considered separately.

### 4.2.3 Definition of operating frequency range

The Operating Frequency Range (OFR) is the total range of frequencies covered either by one type, or by a family of equipment.

It is noted that a family of equipment may be capable of covering a wider frequency range than the alignment range of one type of equipment.

## 4.3 Definition of the categories of the alignment range (AR0, AR1, AR2 and AR3)

The alignment range falls into one of four categories:

- the first category, defined as AR0, corresponds to equipment having an alignment range of less than or equal to 5 MHz;
- the second category, defined as AR1, corresponds to an alignment range greater than 5 MHz but less than or equal to 30 MHz;
- the third category, defined as AR2, corresponds to an alignment range greater than 30 MHz, but less than or equal to 60 MHz;
- the fourth category, defined as AR3, corresponds to an alignment range greater than 60 MHz.

## 4.4 Testing of equipment of category AR0

Full tests shall be carried out on a channel within 50 kHz of the centre frequency of the alignment range, category AR0.

## 4.5 Testing of equipment of category AR1

Full tests shall be carried out on a channel within 50 kHz of the highest frequency of the alignment range and full tests on a channel within 50 kHz of the lowest frequency of the alignment range.

## 4.6 Testing of equipment of category AR2

Full tests shall be carried out on a channel within 50 kHz of the highest frequency of the alignment range and full tests on a channel within 50 kHz of the lowest frequency of the alignment range.

Limited tests shall be carried out on a channel within 50 kHz of the centre frequency of the alignment range.

## 4.7 Testing of equipment of category AR3

Full tests shall be carried out on two channels, one within 50 kHz of the highest, and one within 50 kHz of the lowest frequency of the alignment range.

Limited tests shall be carried out on intermediate test channels, equally spaced ( $\pm 50$  kHz) over the alignment range and chosen such that the gaps between the test channels do not exceed 30 MHz.

## 4.8 Testing of equipment capable of operating with more than one channel separations

For equipment which can be operated with more than one channel separation, measurements shall be performed in accordance with subclauses 4.4, 4.5, 4.6, and 4.7, for each of these channel separations, as indicated in table 1, without the need of testing for both 20 kHz and 25 kHz (see note 2 in table 1).

## 4.9 Number of samples for type testing

If the Switching Range (SR) of each equipment corresponds to its alignment range category (AR0, AR1, AR2, or AR3) then only one sample shall be tested (see figure A.1)

If the switching range of the equipment is a subset of the equipment's alignment range, then the following samples shall be tested in order to cover the whole of that alignment range:

- for category AR0, one sample shall be provided for testing on a channel in the vicinity of the centre of the alignment range AR0, as specified in subclause 4.4;
- for category AR1, two samples shall be provided, one sample for testing at a channel close to the upper edge and the other sample for testing close to the lower edge of the alignment range AR1, as specified in subclause 4.5;
- for category AR2, three samples shall be provided, one sample for testing at a channel close to the upper edge, one sample for testing close to the lower edge and the other sample for testing in the vicinity of the centre of the alignment range AR2, as specified in subclause 4.6;
- for category AR3, four or more samples shall be provided, one sample for testing at a channel close to the upper edge, one sample for testing close to the lower edge, and two or more samples for testing at a corresponding number of intermediate channels, as specified in subclause 4.7.

See clause A.2 for details of the number of samples and tests.



**Table 1: Measurements for equipment with more than one channel separation**

Channel Separations	12,5 kHz, 20 kHz or 25 kHz (note 1)		
Frequency of the measurement	FR <sub>L</sub>	FR <sub>C</sub>	FR <sub>H</sub>
Alignment Range			
AR0	-	FT	-
AR1	FT	-	FT
AR2	FT	LT (note 2)	FT
AR3	FT	LT (note 3)	FT
Legend: FT - Full tests. LT - Limited tests. FR <sub>L</sub> - Lower end of frequency range. FR <sub>C</sub> - Centre of frequency range. FR <sub>H</sub> - Higher end of frequency range.			
NOTE 1: If measurements are performed with a channel separation of 20 kHz on equipment designed to operate as well on 20 kHz as on 25 kHz separations without any physical change, there is no need to perform tests with a channel separation of 25 kHz.			
NOTE 2: Limited tests for AR2 need only be performed on a channel in the centre of the frequency range for either 12,5 kHz or 20/25 kHz channel separation.			
NOTE 3: For equipment of category AR3, limited tests shall be performed on test channels at intermediate frequencies of the alignment range (see subclause 4.7).			
The alignment range and frequencies used for the measurements shall be noted in the test report.			

## 4.10 Testing of a family of equipment with a total operating range in excess of each equipment's alignment range

A family of equipment may be capable of covering a wider frequency range than the alignment range of one type of equipment by the use of frequency range determining components other than those specified in subclause 4.2 and fulfilling appropriate requirements.

If this is the case, then for the purposes of type testing, the operational frequency range shall be presented as two or more alignment ranges, as appropriate, each of which is considered to be category AR0, AR1, AR2, or AR3, according to the definition in subclause 4.3.

Full tests shall be carried out on a channel within 50 kHz of the highest frequency of the Operating Frequency Range (OFR) and full tests shall be carried out on a channel within 50 kHz of the lowest frequency of the OFR:

- for category AR1, limited tests shall be carried out on a channel within 50 kHz of the outer edges of the alignment ranges within the OFR, except for the channels coinciding with the highest and lowest frequencies of the OFR where full tests shall be carried out;
- for category AR2, tests shall be in accordance with subclause 4.6;
- for category AR3, tests shall be in accordance with subclause 4.7.

See clause A.3 for examples.

## 4.11 Testing of equipment with alternative transmitter power levels

If an equipment is designed to operate with different carrier power levels, provided that the power can be adjusted, programmed or remotely controlled without any physical changes, measurements of each transmitter parameter shall be performed at the lowest and highest power levels at which the transmitter is intended to operate.

## 4.12 Testing of equipment with alternative hardware configurations

If a family of equipment has alternative output power levels provided by the use of separate power modules or add on stages, or additionally has alternative channel separations (as described in subclause 4.8), then each module or add on stage shall be tested in combination with the equipment. The necessary samples and tests can be proposed by the manufacturer (or applicant) and/or test laboratory and shall be agreed with the Administration(s), based on the requirements of clause 4.

## 4.13 Testing of equipment that does not have an external 50 $\Omega$ RF connector (integral antenna equipment)

This subclause applies only to such equipment which does not have an external 50  $\Omega$  RF connector (integral antenna equipment) but which allows for an internal RF access for the purpose of performing conducted measurements.

Equipment having an internal permanent antenna connector shall be tested in accordance with subclause 4.13.1.

Equipment which is to be tested using a "temporary antenna connector" shall be tested in accordance with subclauses 4.13.1 and 4.13.2.

### 4.13.1 Equipment with an internal permanent or temporary antenna connector

The means to access and/or implement the internal permanent or temporary antenna connector shall be stated by the applicant or his authorized representative with the aid of a diagram. The fact that use has been made of the internal antenna connector or of a temporary connection to facilitate measurements shall be recorded in the test report.

NOTE: For example, this "temporary antenna connector" might be implemented using a 50  $\Omega$  connection point which would be normally used for connection to the antenna.

No connection shall be made to any internal permanent or temporary antenna connector during the performance of radiated emissions measurements, unless such action forms an essential part of the normal intended operation of the equipment, as declared by the manufacturer.

### 4.13.2 Equipment with a temporary antenna connector

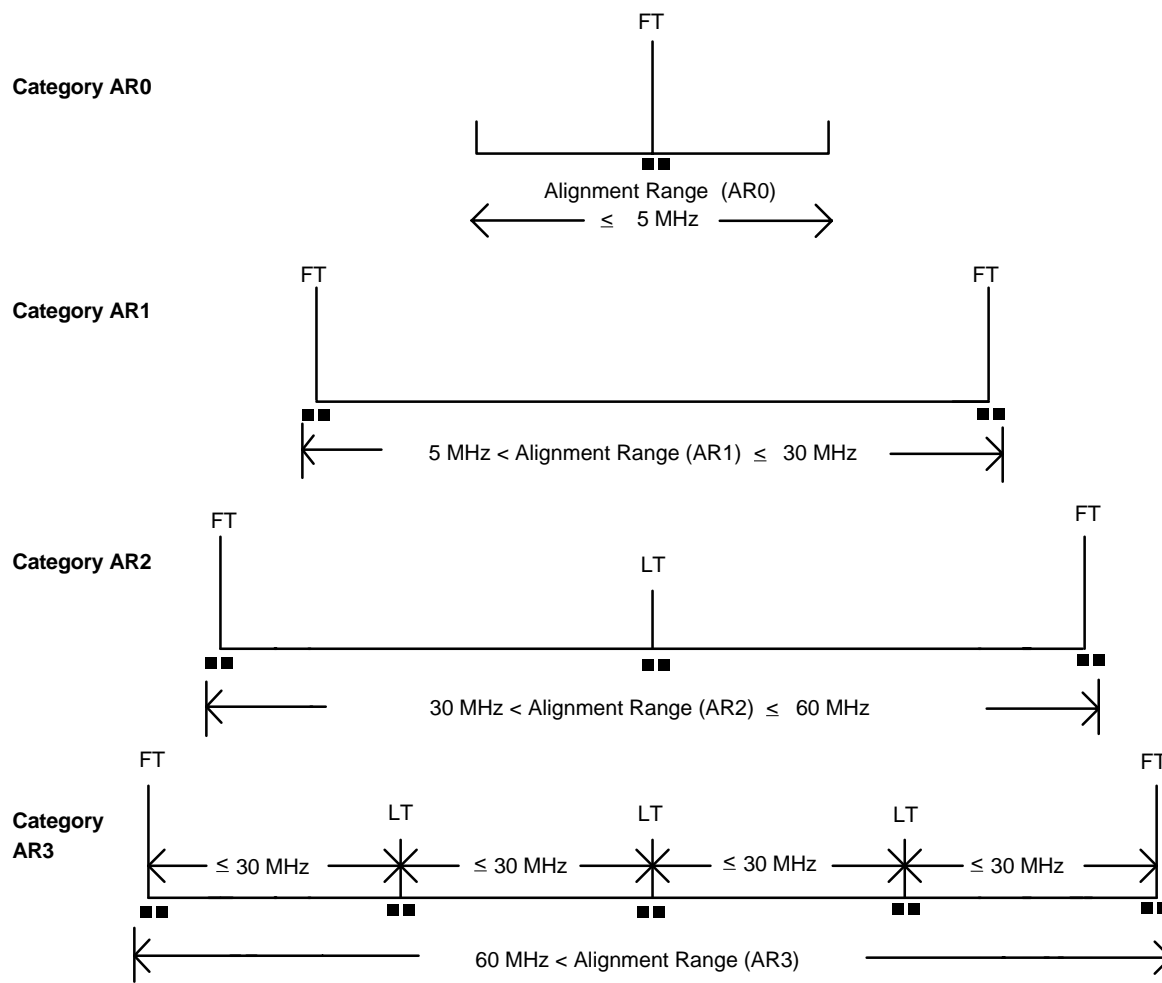
The manufacturer or his representative may submit one set of equipment with the normal antenna connected, to enable the radiated measurements to be made. He shall attend the test laboratory at conclusion of the radiated measurements, to disconnect the antenna and fit the temporary connector. The testing laboratory staff shall not connect or disconnect any temporary antenna connector.

Alternatively the manufacturer or his representative may submit two sets of equipment to the test laboratory, one fitted with a temporary antenna connector with the antenna disconnected and the other with the antenna connected. Each equipment shall be used for the appropriate tests. The manufacturer shall declare that two sets of equipment are identical in all respects.

## Annex A (normative): Graphical representation of the selection of equipment and frequencies for testing

### A.1 Tests on a single sample

If the Operating Frequency Range (OFR) of each equipment corresponds to its alignment range (AR0, AR1, AR2, or AR3) then only one sample shall be tested.



NOTE:

AR0, AR1, AR2, AR3

FT

LT

■ ■

Categories of alignment range, see subclause 4.3.

Full tests.

Limited tests.

50 kHz range in which tests are carried out.

Figure A.1: Tests on a single sample for equipment that has a switching range equal to its alignment range

## A.2 Tests and samples needed when the switching range is a subset of the alignment range

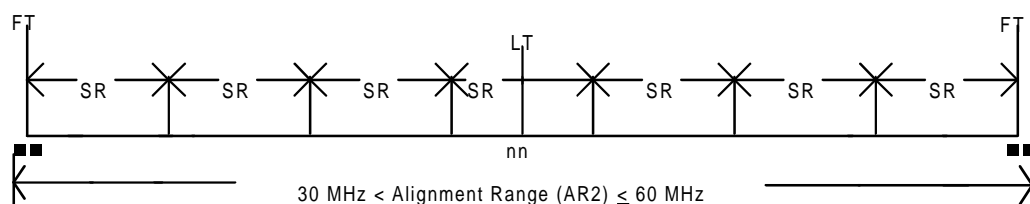
In order to cover an alignment range several separate samples, having different switching ranges (SR) within the alignment range, may be needed. Samples shall be then provided for testing in accordance with subclauses 4.4, 4.5, 4.6, and 4.7, as appropriate. The following examples assume a switching range (SR) of 5 MHz.

### Category AR1



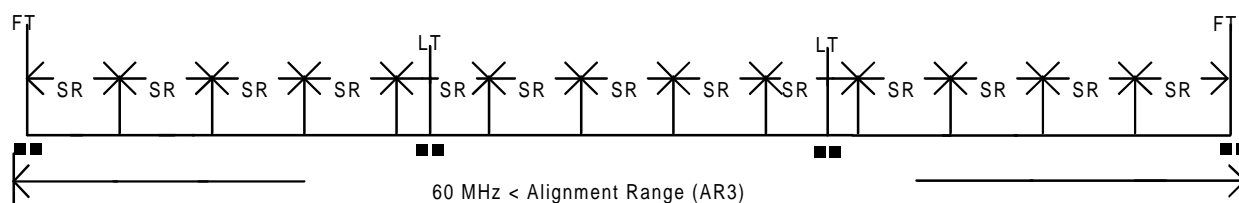
2 Samples, 2 FT

### Category AR2



3 Samples, 2 FT, 1 LT.

### Category AR3



4 Samples, 2 FT, 2 LT.

#### NOTE:

SR	Switching Range, see subclause 4.2.
AR1, AR2, AR3	Categories of alignment range, see subclause 4.3.
FT	Full tests.
LT	Limited tests.
■ ■	50 kHz range in which tests are carried out.

Figure A.2: Tests on equipment having switching ranges that are subsets of their alignment range

## A.3 Tests and samples for a family of equipment where the alignment range is a subset of the total operating frequency range

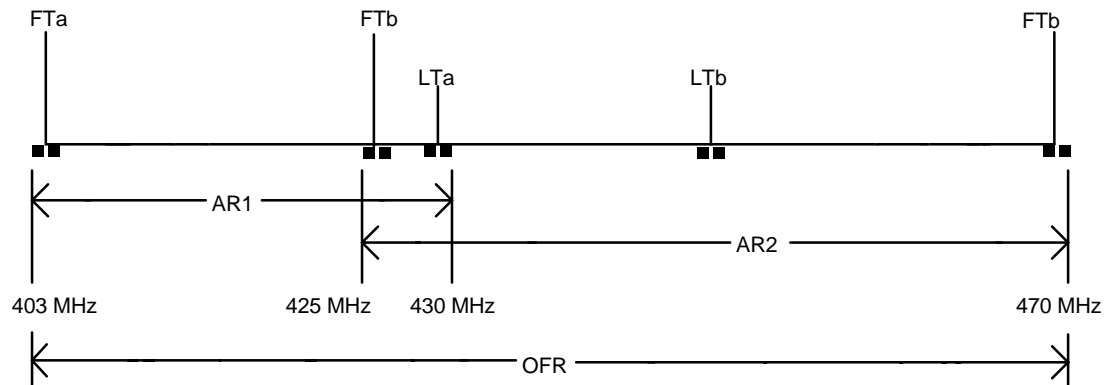
If the alignment range of a piece of equipment is a subset of the total operating frequency range then the operating frequency range shall be divided into appropriate categories of alignment range. Samples shall be then provided for testing in accordance with subclauses 4.4, 4.5, 4.6, and 4.7, as appropriate.

For example the applicant seeks type approval for a family of equipment having an operating frequency range of 403 MHz to 470 MHz. The equipment to be tested does not cover this range with one category of alignment range.

### A.3.1 Test scenario 1

The Operating Frequency Range (OFR) could be covered by two alignment ranges a) and b), implemented in samples a) and b):

- a) 403 MHz to 430 MHz: This is category AR1;
- b) 425 MHz to 470 MHz: This is category AR2.



**NOTE:**

- OFR Operating Frequency Range, see subclause 4.2.
- AR1, AR2 Categories of alignment range, see subclause 4.3.
- FTa Full tests on sample(s) a).
- LTa Limited tests on sample(s) a).
- FTb Full tests on sample(s) b).
- LTb Limited test on sample(s) b).
- 50 kHz range in which tests are carried out.

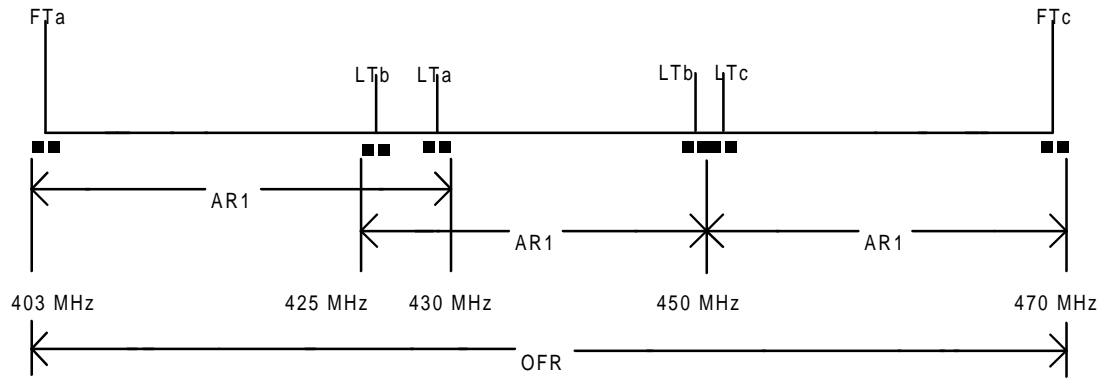
This example requires a minimum of two test samples and a maximum of five test samples to cover the operating frequency range.

**Figure A.3: Tests on family member equipment having alignment ranges that are subsets of the total operating frequency range (Example 1)**

### A.3.2 Test scenario 2

The Operating Frequency Range (OFR) could alternatively be covered by three alignment ranges of category AR1, implemented in samples a), b) and c):

- a) 403 MHz to 430 MHz: this is category AR1;
- b) 425 MHz to 450 MHz: this is category AR1;
- c) 450 MHz to 470 MHz: this is category AR1.



## NOTE:

- OFR      Operating Frequency Range, see subclause 4.2.
- AR1      Second category of alignment range, see subclause 4.3.
- FTa      Full tests on sample(s) a).
- LTa      Limited tests on sample(s) a).
- LTb      Limited test on sample(s) b).
- FTc      Full tests on sample(s) c).
- LTc      Limited tests on sample(s) c).
- 50 kHz range in which tests are carried out.

This example requires a minimum of three test samples and a maximum of six test samples to cover the operating frequency range.

**Figure A.4: Tests on family member equipment having alignment ranges that are subsets of the total operating frequency range (Example 2)**

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## Annex B (informative): Examples of limited tests in ETSI standards

The present document has been drafted in support of a variety of product standards. In some of them the concepts of "full tests" and "limited tests" has been developed.

The purpose of this annex is to provide further information on such concepts (e.g. on "limited tests"), for readers not familiar with those standards where these concepts have been used.

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### B.1 Limited tests

This annex contains examples of "limited tests" as specified in some ETSI radio product standards. "limited tests" are not used in all product standards, nor are they necessarily the same for every radio product standard. The following text provides examples showing how the concept has been implemented in two particular cases.

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### B.2 Example of limited tests from ETS 300 086

The limited tests referred to in subclauses 4.1 to 4.12 of the present document include for ETS 300 086 [1]:

- transmitter frequency error, (see subclauses 4.1.1 and 7.1 of ETS 300 086 [1]);
- transmitter carrier power (conducted), (see subclauses 4.1.2 and 7.2 of ETS 300 086 [1]);
- transmitter effective radiated power, integral antenna equipment only, (see subclauses 4.1.3 and 7.3 of ETS 300 086 [1]);
- transmitter adjacent channel power, (see subclauses 4.1.5 and 7.5 of ETS 300 086 [1]);
- receiver maximum usable sensitivity (conducted), (see subclauses 4.2.1 and 8.1 of ETS 300 086 [1]);
- receiver maximum usable sensitivity (field strength), integral antenna equipment only, (see subclauses 4.2.2 and 8.2 of ETS 300 086 [1]);
- receiver adjacent channel selectivity, (see subclauses 4.2.5 and 8.5 of ETS 300 086 [1]).

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### B.3 Example of limited tests from ETS 300 341

The limited tests referred to in subclauses 4.1 to 4.12 of the present document include for ETS 300 341 [2]:

- transmitter frequency error, (see subclauses 5.1.1 and 8.1 of ETS 300 341 [2]);
- transmitter effective radiated power, (see subclauses 5.1.2 and 8.2 of 300 341 [2]);
- transmitter adjacent channel power, (see subclauses 5.1.3 and 8.3 of 300 341 [2]);
- receiver average usable sensitivity (field strength, responses), (see subclauses 5.2.1 and 9.1 of ETS 300 341 [2]);
- receiver adjacent channel selectivity, (see subclauses 5.2.3 and 9.3 of ETS 300 341 [2]).

## History

<b>Document history</b>				
	December 1996	Public Enquiry as ETS 300 793	PE 119:	1996-12-02 to 1997-03-28
V1.1.1	November 1997	Vote	V 9803:	1997-11-18 to 1998-01-16
V1.1.1	February 1998	Publication		