

Rake Level Radio Frequency Interference Test for High Speed Train set (B28)

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1 Introduction

This document is intended to Radio Frequency Interference Test of High Speed Train set (B28) rake as per the specification ICF/MD/SPEC-447, the Radio Frequency compatibility Test to be conducted as per IEC 61133. The complete Test is listed in clause No. 9.15.3 namely “Radio Frequency Interference”.

2 Objective and Scope of the Test

Objective: To verify that the vehicle does not produce excessive electromagnetic interference at radio frequencies.

The test shall be conducted in accordance with IEC 62236-3-1 unless otherwise agreed in the contract, at the critical frequencies and maximum levels defined therein.

3 Introduction to the system

Train should be designed as per ICF specification ICF/MD/SPEC-447.

3.1 System Overview

One basic unit of 4-car unit is the building block for Train Set rake formation. Each basic unit consists of one Driving Trailer Coach (DTC) at the end, two Motor Coaches(MC) and one Trailer Coach (TC).

Two such basic units can be coupled together to form one rake of 8 coaches. Formation of basic unit is shown below:

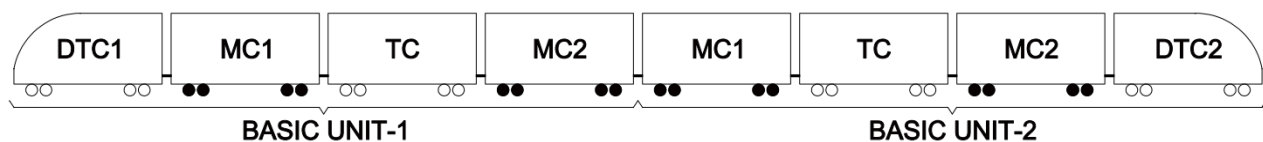


Figure 1: Train Formation

Driving Trailer Coach (DTC) is a non-powered vehicle with a Driver cab at one end. The Driver cab is furnished with a pre-fabricated Driver Desk. All driving operations are possible from Driver Desk. Feedback from all systems in all the coaches / basic units is available for viewing on the Driver Desk and certain functionalities can be controlled from the Driver Desk. In this regard a 10.4” Touch Based TFT display is provided on driver desk for showing combined status. Various gauges and indications are also provided on driver desk for knowing MR, BC and parking brake pressure. The driver will also be able to control/operate the Passenger Information System, Train Radio from the Driver Desk. It also consists of LVPS with battery charger & battery and main air compressor which are mounted underslung. Rest of the DTC apart from the Driver cab is Passenger saloon area and vestibules. Two electrical cabinets are placed in rear wall of driver cab and one more electrical cabinet at non driving end. All passenger comfort related loads can be controlled by driver from driver cab.

Motor Coach (MC) is a powered vehicle with one Traction Motor driving each axle. The Motor Coach contains a line and traction converter unit (LTC) for each bogie mounted underslung.

Transformer secondary cable for both LTC units comes from power transformer mounted in Trailer Coach through underslung mounted IV Coupler. It also consists of 2 no's electrical cabinets.

Trailer Coach (TC) contains a pantograph, vacuum circuit breaker, surge arrestors and isolator on roof. It also consists of auxiliary converter units and power transformer mounted underslung. Power to LTC units of both motor coaches is distributed from same power Transformer through Power Coupler. It also consists of 2 no's electrical cabinets.

In trailer coach there are 2 variants i.e TC coach in basic unit 2 is for executive class and the TC coach in basic unit 1 is for standard class.

All the passenger saloon areas are provided with air condition, controlled using HVAC(2no's) units mounted in each coach. All electrical cabinets, driver cab and passenger saloon areas are provided with fire detection equipment.

All the coaches are provided 4no's of airtight plug type exterior doors for passenger entry/exit. In addition all coaches are provided with automatic internal doors duly segregating passenger saloon area and door way vestibule area.

All the coaches including driver cab are provided with CCTV cameras and passenger information system.

4 List of Abbreviations used

Acronym	Description
AC	Alternating Current
DTC	Driving trailer coach
ICF	Integral Coach Factory (Coach Builder)
IEC	International Electro technical Commission
MAHSR	Mumbai Ahmedabad High Speed Rail
MC	Motor Coach
NHSRCL	National High Speed Rail Corporation Limited
TC	Trailer Coach
TCMS	Train Control and Management System
VCB	Vacuum Circuit Breaker

Table 1: List of Abbreviations

5 Applicable Documents and Standards

5.1 Customer Specification

5.1.1 ICF specification ICF/MD/SPEC-447

SPECIFICATIONS AND STANDARDS FOR DEVELOPMENT OF NEW GENERATION ENERGY EFFICIENT TRAIN WITH DISTRIBUTED POWER SYSTEM (LIGHT WEIGHT STAINLESS STEEL BODIES CARS)" and its subsequent Statement of Deviations accepted by

ICF/NHSRCL.

5.1.2 ERTS – Employer’s Requirements Technical Specifications of Project for Construction of Mumbai-Ahmedabad High Speed Rail

5.2 Other Standards

Standard	Description	Contains
IEC 61133	Electric traction; rolling stock; test methods for electric and thermal/electric rolling stock on completion of construction and before entry into service	Objective and Scope of test
EN 50121-3-1:2017 / IEC 62236-3-1	Railway applications – Electro-magnetic compatibility – Part 3-1: Rolling stock – Train and complete vehicle	Test site requirements, conditions and method of measurement & Equipments
EN 50121-2:2017/ IEC 62236-2	Railway applications: Electromagnetic compatibility Part 2, Emissions of the whole railway system to the outside world	Position, location, type and other features concerning the antennas
EN55011/ CISPR-1-1	Industrial, scientific and medical equipment- Radio frequency disturbance characteristic- Limits and method of measurements	Measuring apparatus described

Table 2: Applicable standards

6 Description of Test

6.1 Test Pre - Requisites

- All apparatus to be integrated into a vehicle should meet the requirements of Part EN50121-3-2/IEC62236-3-2. It is the responsibility of supplier to get the individual apparatus tested as per specified standards.
- The EMC-tests shall be carried out on a fully equipped 8-car high Speed trainset
- All system and subsystem shall be energized which could contribute to electromagnetic interference. Before starting the test, permission shall be received from NHSRCL regarding the test.
- No other vehicles shall be present on test track.
- No maintenance work or unnecessary switching of power supply which can create noise.
- Other requisites related to site are covered in test site requirements.

6.2 Test Site Requirements

6.2.1 Test Site

The test site shall meet as far as possible the “free space “requirements below within the existing constraints of the railway environment:

- No trees, walls, bridges, tunnels or vehicles shall be close to the measurement point, minimum separation distance of 30 meter.
- As the railway system is powered by a OHE line, since it is impossible to avoid the support

masts of the overhead, the measurement point shall be at the midpoint between masts, on the opposite side of the track (in case of a double track, on the side of the track which is being used).

- The overhead rail should be an “infinite” line on both sides of the measurement point, the minimum clear length on both sides of the measurement point should be 3 km.
- Overhead rail discontinuities as well as substations, transformers, neutral sections, section insulators shall be avoided.
- The exact location of the test site and features of both the site and the Overhead rail system layout shall be noted.
- The contribution of the substation may be considered when assessing the emissions from the vehicle. Note that the contribution of a ac substation depends on its load current and will not be measured properly in a no-load condition. For this reason close proximity to power lines including buried lines, substations, etc. should be avoided.
- No other railway vehicle should be operating in the same feeding section or within a distance of 20 km (as specified for urban vehicles).

If these conditions are not possible, the ambient noise before and after each emission measurement of the vehicle under test shall be recorded. Otherwise only two ambient noise measurements at the beginning and the end of the test series are sufficient.

If at specific frequencies or in specific frequency ranges the ambient noise is higher than the limit values less 6 dB, the measurements at these frequencies need not be considered. These frequencies shall be noted in the test report.

6.2.2 Test Conditions

The tests shall cover the operation of all systems on-board and Underslung rolling stock which may produce radiated emissions.

Main line vehicle shall be tested while stationary in an energized mode (auxiliary converters, battery chargers, etc. in operation). The antenna should be sited opposite the equipment expected to produce the greatest emissions at the frequencies under measurement.

Main line vehicle shall be tested while stationary and at slow moving speed. During the stationary test, the auxiliary converters shall operate (it is not inevitably under maximum load conditions that the maximum emission level is produced) and the traction converters shall be under voltage but not operating. The antenna should be sited opposite the vehicle center line unless an alternative location is expected to produce higher emission levels.

For the slow moving test, the speed shall be low enough to avoid arcing at or bouncing of the sliding contact and high enough to allow for electric braking. The recommended speed range is (50 $\pm$ 10) km/h. When passing the antenna, the vehicle shall accelerate or decelerate with approximately 1/3 of its maximum tractive effort within the given speed range.

As per recommendation of EN50121-2:2017, Antenna shall be placed opposite to site which is expected to produce highest emission in rake formation. As MC coach consists of all power equipment and MC of BU2 and MC of BU3 comes in middle of rake, antenna shall be placed near MC of BU2 or MC of BU3.

Loop antenna

The plane of the loop antenna shall be vertical and parallel to the line of the track. The height above the rail shall be 1.0-2.0 m and the distance to the middle point of the track 10 m, measured from the center of the loop (Figure 2).

Biconical / log periodic antenna

The biconical / log periodic antenna shall be arranged to measure the vertical field component. The height above the rail shall be 3.0 m, measured from the center of the antenna (Figure 3, Figure 4).

6.2.3 Weather conditions

Weather conditions as defined in clause 5.4.1 of IEC 62236-2 are as below.

To minimize the possible effect of weather on the measured values, measurements should be carried out in dry weather, (after 24 h during which not more than 0,1 mm rain has fallen), with a temperature of at least 5 degree C, and a wind velocity of less than 10 m/s.

Humidity should be low enough to prevent condensation on the power supply conductors.

Since it is necessary to plan the tests before the weather conditions can be known, tests will have to be made in weather conditions which do not meet the target conditions. In these circumstances, the actual weather conditions shall be recorded with the test results.

7 Test Equipment and Test Set-up

7.1 Test Body Requirements

Assign test body should be accredited for doing EMI/EMC test.

7.2 Measuring Equipment and Test method

Tools & Measurement Equipment will be scope of Third Party. The third party will follow the following methods as per Annexure B to IEC 62236-3-1.

To reduce test duration, the frequencies scanning techniques is used. This can be done either by a spectrum analyzer or a computer controlled receiver. Each frequency range is divided into several sub ranges.

Each evaluation of a train or a vehicle consists in doing a test of each sub-range.

The apparatus shall scan this sub-range continuously and memorize the maximum values reached during the test. This can be achieved by the “peak hold” function or under computer control of the apparatus. This method assumes that the level and characteristics of electromagnetic noise do not vary significantly during each scan.

The position, location, type and other features concerning the antennas are the same as described in IEC 62236-2.

The peak measurement method is used. The duration at selected frequency shall be sufficient to obtain an accurate reading. This is a function of the measuring set and the recommended value is 50

ms.

Frequency bands and bandwidths at –6 dB used for measurements are in accordance with EN55016-1-1.

These are:

Frequency bands	0,15-30 MHz	30-300 MHz	300 MHz -1 GHz
Bandwidth	9 kHz	120 kHz	120 kHz

The measuring apparatus shall be in accordance with the CISPR 16-1-1/EN 55016-1-1 requirements described in sub clause 4.2: Peak measuring receivers for the frequency range 150 kHz to 1 GHz.

Following table data may be used as a guideline for the test.

Band	Subrange Hz	Span ^a Hz	Bandwidth kHz	Sweep time ^b ms
150kHz – 30MHz	150k – 1.15M	1M	9 or 10	37
	1M – 11M	10M	9 or 10	370
	10M – 20M	10M	9 or 10	370
	20M – 30M	10M	9 or 10	370
30MHz – 1GHz	30M – 230M	200M	100 or 120	42
	200M – 500M	300M	100 or 120	63
	500M – 1G	500M	100 or 120	100
^a for a spectrum analyser				
^b may be slightly different from one instrument to another				

Table 3: Guidelines for the test

Measurement equipment should be listed, copies of calibration certificates should be available before tests starts.

Following equipment is normally used for emission measurement:

Designation	Quantity
DC supply for Testing	1
H field Antenna for 150 KHz to 30 MHz	1
E field Antenna for 30 MHz to 300 MHz biconical and 300 MHz to 1000 MHz Log periodical antenna	1 for each
Test Receiver and Spectrum analyzer for 150 KHz to 1000MHz	1
EMI pre selector, if not integrated into receiver	1
Relevant cables, software and interface	1

Calibrated antenna factors are used to convert the terminal voltage of the antenna to field strength

Table 4: Equipment details

The choice of instruments used and their set-up shall be such that measurements made can be interpreted with respect to the:

- location of measuring transducer,
- accuracy,
- bandwidth,
- dynamic range,
- quantification of systematic errors; e.g. noise, intermodulation effects, etc.,
- system response to evaluate signals within both frequency and time domains,
- measurement of modulation between frequencies or other gabarit specified criteria,
- recording of speed, location, traction power supply parameters and other factors which may have an influence on the level of interference currents generated,
- procedural calibration checks.

Additional equipment and man power is needed for the test execution:

- Power supply 230 VAC, 500 W (emergency power system) for the measurement equipment
- Cable drum with socket outlet (50m)
- Walkie-talkie (4 set) for communication with drivers
- Mobile phone (safety reason)

Any other equipment mentioned in the relevant IEC standard as per requirement of test condition, Test site.

7.3 Emission tests and limits

The emission tests and limits for rolling stock in this standard should ensure as far as possible that the rolling stock does not interfere with typical installations in the vicinity of the railway system.

Measurements shall be performed in well-defined and reproducible conditions. It is not possible to totally separate the effects of the railway system and the stock under test. Therefore, the operator and the manufacturer have to define in the contract the test conditions and the test site for compatibility with signaling and communication systems and for interference on telecommunication lines, (e.g. load conditions, speed and configuration of the units). For radiated emissions, the test conditions are defined in 6.2.2 and 6.2.3. The contributions of other parts of the railway system (e.g. substations, signaling) and of the external environment (e.g. power lines, industrial sites, radio and television transmitters) to the measurements must be known and taken into account.

7.4 Test Setup

- The preferred distance of the measuring antenna from the center line of the track on which the vehicle is moving is 10 m. In the case of the log-periodic antenna, the 10 m distance is measured to the mechanical center of the array. The height above rail level of the antenna center shall be within the range 1.0 m to 2.0m for the loop antenna, and within 2.5 m to 3.5 m to the center of dipole or log-periodic antennas. If the level of the ground at the antenna differs from the rail level by more than 0,5m, the actual value shall be noted in the test

report.

- The plane of the loop antenna shall be vertical and parallel to the line of the track. The biconical dipole shall be placed in the vertical and horizontal axis.
- The log periodic antenna shall be arranged to measure the vertical and horizontal polarisation signal, with the antenna directed towards the track.
- During the emission two kind of field measurements are done H Field and E field. For lower frequency upto 30 MHz H field will dominates and for frequency above 30 MHz E field will dominates.
- Antenna arrangement shall be as per EN50121-2. For H field measurement, Loop Antenna shall be used. For measurement of E field, Bi-conical, Log-periodical antenna shall be used. Arrangement of Antenna for various frequency are given below:

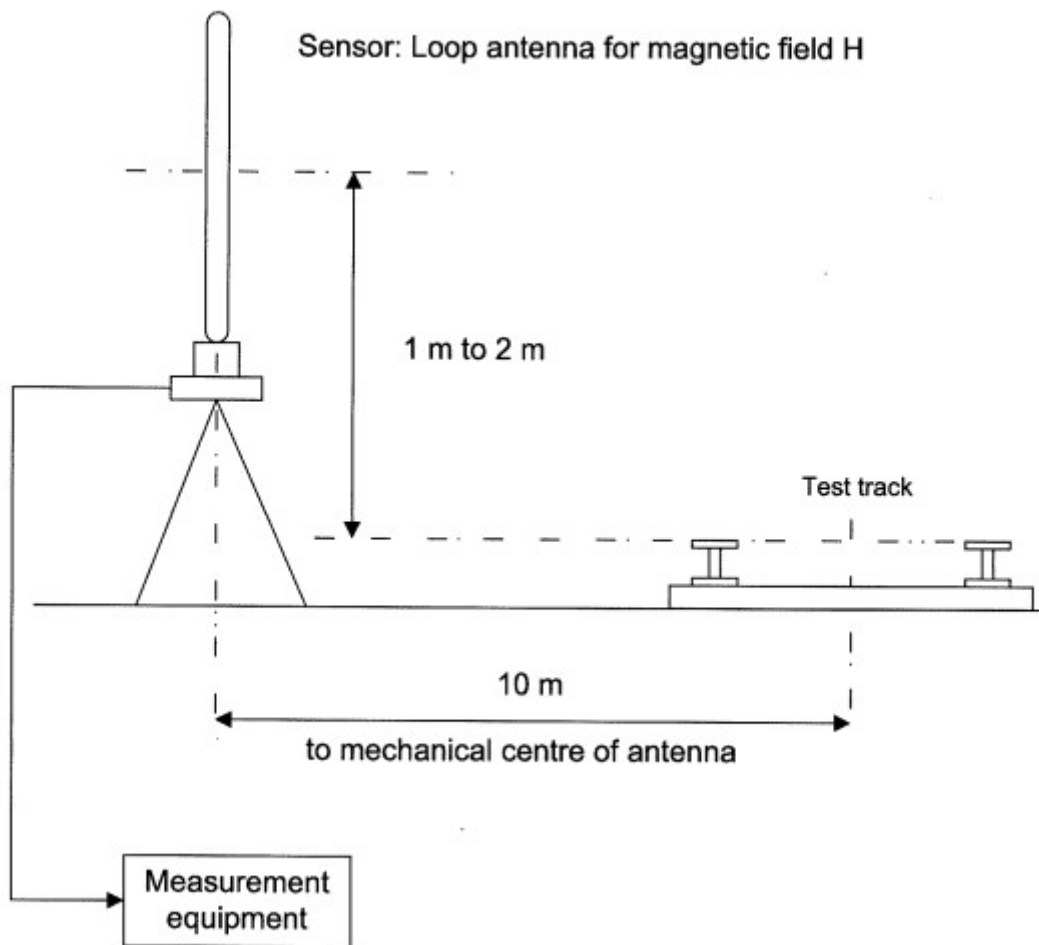


Figure 2: Position of Antenna for measurement of Magnetic field for 150 KHz to 30 MHz Frequency band (According to EN50121-2:2017)

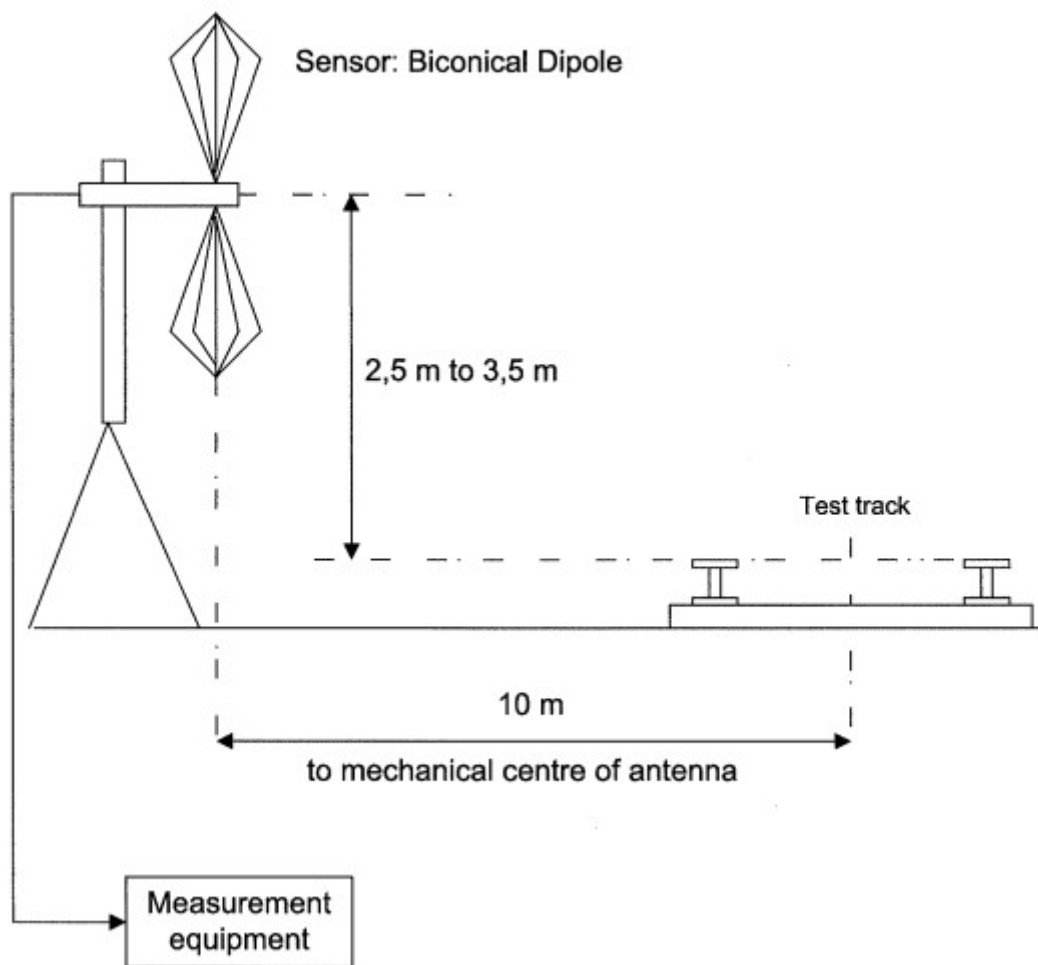


Figure 3: Position (vertical polarisation) of Antenna for measurement of Electric field for 30 MHz to 300 MHz Frequency band (According to EN50121-2:2017)

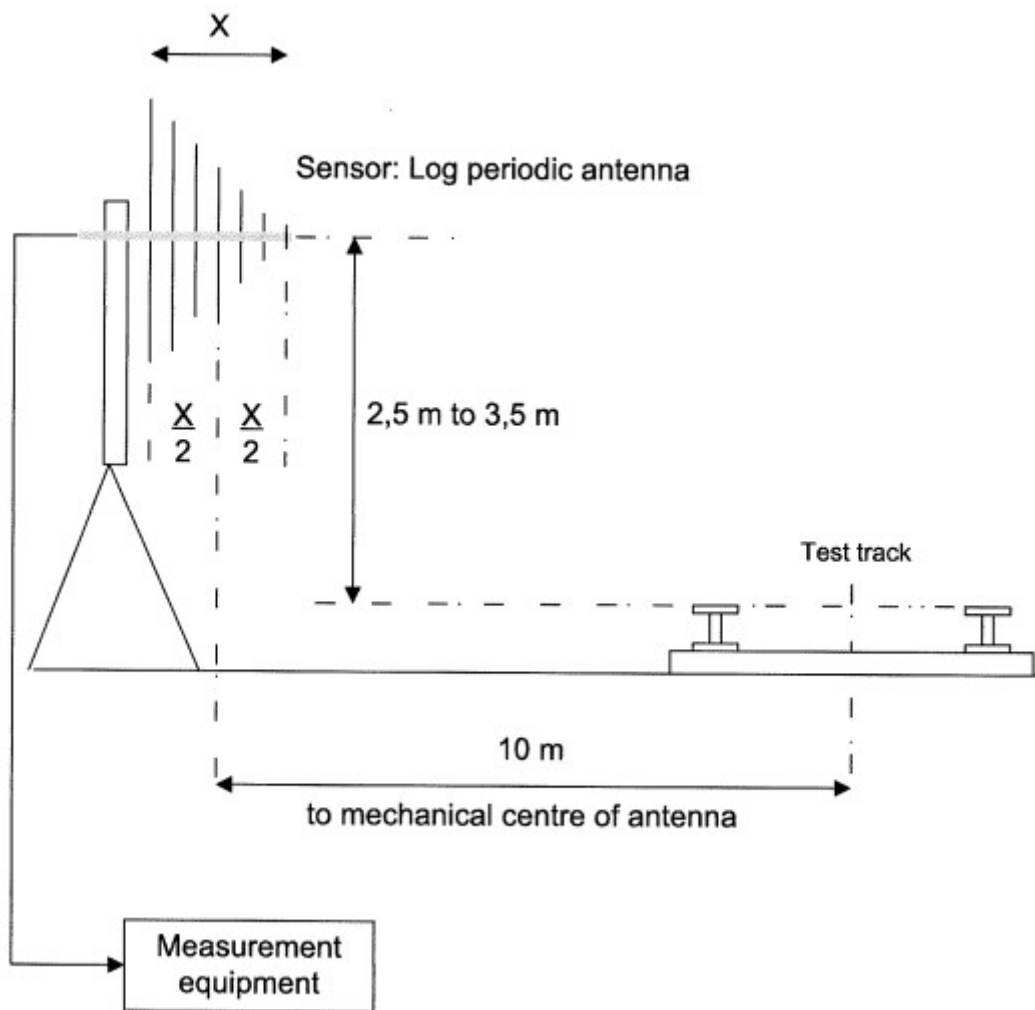


Figure 4: Position (vertical polarization) of Antenna for measurement of Electric field for 300 MHz to 1 GHz Frequency band (According to EN50121-2:2017)

The radio frequency emission will be affected by the state of the railway supply system. Switching of feeder stations and temporary works will influence the response of the system. It is therefore necessary to note the condition of the system in the test record and, if possible, all similar tests should be carried out within the same working day. Where the railway has a track-side conductor rail power supply, the test location should be at least 100 m from gaps in the rail, to avoid inclusion of the transient fields associated with the make and break of collector contact. The conductor rail and the antennas shall be on the same side of the track.

The test sites do not correspond to the definition of a completely clear site because they are influenced by overhead structures, rails and the catenary. However, wherever possible, antennas shall be placed well away from reflecting objects. If overhead power lines are nearby, other than those which are part of the railway network, they should be no closer than 100 m to the test site.

The values measured are expressed as:

- dB μ A/m for magnetic fields,

- dB μ V/m for electrical fields.

These are obtained by using the appropriate antenna factors and conversions.

Background noise shall be measured at the test site in the absence of train effects. This will give the noise values from the energised power supply conductors. If this is significant, it is advisable to measure also at 100 m from the test site, to identify any high non-railway sources of noise.

7.4.1 Frequency selection

7.4.1.1 Selected frequencies

The selection of the actual frequencies to be measured will depend on the circumstances of the test site. If high signals exist, for example from public broadcasting stations, the selection of test frequencies shall take this into account. It is recommended that test frequencies are selected so that there are at least three frequencies per decade.

7.4.1.2 Sweep frequency

In view of the short time available for measurement in one train passage, the use of a sweep frequency measuring technique, in which the peak noise is measured with a peak-hold circuits, the frequency is changed, may offer adequate information concerning generation of noise. There will still remain problems of time because the rate of change of frequency is a function of the bandwidth, due to considerations of accuracy. A sweep analyzer will usually set its own sweep rate to meet this requirement. If this method is used, sweep rate as well as bandwidth shall be noted.

7.4.2 Transients

During the test, transients due to switching may be detected, such as those caused by operation of power circuit breakers. These shall be disregarded when selecting the maximum signal level found for the test.

7.5 Test Description

To cover the full frequency range, as described in the clause 5.1.1 of standard IEC 62236-2 antennas of different design are required. Typical equipment is described below:

Antenna shall be placed at MC of BU2 or MC of BU3 location as per arrangement shown in figure 2, 3 and 4. Radio-frequencies emission tests are done for both stationary and slow moving condition.

Following measurement shall be done:

Operation	Description	Antenna type to be used
1	Ambient noise level 150kHz-30 MHz	Loop Antenna
2	Radiated emissions 150kHz – 30 MHz Stationary	Loop Antenna
3	Radiated emissions 150kHz – 30 MHz Slow moving	Loop Antenna
4	Ambient noise level 30MHz-300 MHz	Biconical dipole Antenna
5	Radiated emissions 30MHz-300 MHz Stationary	Biconical dipole Antenna
6	Radiated emissions 30MHz-300 MHz Slow moving	Biconical dipole Antenna
7	Ambient noise level 300MHz-1000 MHz	Log Periodic Antenna
8	Radiated emissions 300MHz-1000 MHz Stationary	Log Periodic Antenna

Operation	Description	Antenna type to be used
9	Radiated emissions 300MHz-1000 MHz Slow moving	Log Periodic Antenna

Table 5: Antenna to be used for various frequency

By slow moving test following point should be considered:

The train should be moved slowly to the measurement area and starts to accelerate 10 meter in front of the antenna position. The vehicle shall pass the antenna in low speed (below 50 km/h) accelerating with 1/3 of its maximum tractive effort. The measurement starts when the first car enters within the $\pm 45^\circ$ sector in the direction of the antenna (app. 10 m). The measurement stops when the end car is leaving the $\pm 45^\circ$ sector (Figure 8) in the direction of the antenna.

The measurement shall also be repeated with the train passing the measuring equipment as above in electrical braking mode with 1/3 of maximum electric braking effort. The speed should be within 50 ± 10 km/h, when train is passing the antenna.

At least one set of measurements covering the entire frequency area in accelerating and braking shall be recorded.

The noise may not attain its maximum value as the traction vehicle passes the measuring point, but may occur when the vehicle is a long distance away. Therefore, the measuring set shall be active for a sufficient duration before and after the vehicle passes by to ensure that the maximum noise level is recorded.

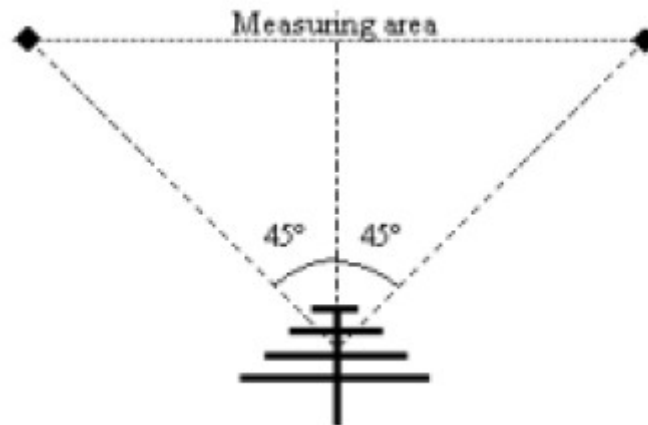


Figure 5: Measurement area of antenna in slow moving mode of train

7.6 Test Procedure

7.6.1 Safety Procedures / Constraints

The tests are performed within the railway infrastructure where hazards may occur due to energized facilities (cables, third rail, train, etc.) and where trains are moving on tracks. Therefore, attendance of the test is permitted to authorized staff only, which is trained and provided with the appropriate safe work procedures, protective equipment and other controls. Prior to access to the test premises

for all involved personal are to be instructed with the specific safety procedures of the site. Basically, in case of unavoidable work on systems which usually are under voltage, the following five safety rules are to be applied prior to any activity on those systems:

1. De-energise
2. Secure against restarting
3. Determine voltage is off
4. Ground and short circuit
5. Cover neighboring energized parts or provide with gates.

Special attention shall be paid to moving trains with regard to the potential threat of collision.

In case of necessary track crossings, it is to be ensured that no train approaches the corresponding track section.

SI No	Potential Hazard	Close out Activity
1	Collision with Train	Follow safety instruction applicable on test site
2	Electric shock from train equipment, cabling etc	Follow safety rules
3	Electric shocks from measuring equipments	Use safety proven equipments. Do not test in rainy seasons

Table 6: Potential Hazard and precautions

7.7 Infrastructure and Surrounding Conditions

Following infrastructure and surrounding conditions should be available/provided for the whole duration of type test on the train level:

- Whole equipped and energized 16 car train
- Agreed and energized part of main line track. See chapter 6.2 for test site requirements

7.8 Technical Staff, Their Skills and Expertise

- Two train operators (drivers)
- All personal participating to the test should be registered, getting advised in measurements and safety procedures
- No other (accredited and/or agreed) staff allowed to approach the test side closer than 25 m

7.9 Applied Measurement Equipment

- Tools & Measurement Equipment will be scope of the Medha test team and/or assigned Third Party
- Measurement equipment should be listed, copies of calibration certificates should available before test

7.10 Test Execution

In reference to figure 3,4,5 of standard IEC 62236-2 Antenna shall be measured as per figure 2 to 4 and Radio frequency interference generated by system installed within 16 car train shall be measured at slow moving (Traction & regeneration braking) and standstill at 150 kHz to 30 MHz and 30 MHz to 1 GHz.

1	Place the train at the midpoint between masts at agreed part of the test track	
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2	Place loop antenna according to section 7.2	
3	All systems of the vehicle shall be shut off (this might require that the supply voltage is disconnected)	
4	Do ambient noise measurements (150 kHz – 30 MHz)	
5	The auxiliary converters shall be in operation and all systems in the vehicle shall be active. The traction converters shall be under voltage but not in operation	
6	Do measurements at train stationary state (150 kHz – 30 MHz)	
7	Do measurements slow moving test (150 kHz – 30 MHz) in accelerating	
8	Do measurements slow moving test (150 kHz – 30 MHz) in braking	
9	Repeat points 1-8 for measurement of E-Field (30 MHz – 300 MHz) • change frame antenna to biconical dipole • ambient noise measurements • measurements at train stationary state • slow moving test in accelerating • slow moving test in braking • ambient noise measurements	
10	Change antenna polarization and repeat points 1-8 for measurement of E-Field (30 MHz – 300 MHz) • ambient noise measurements • measurements at train stationary state • slow moving test in accelerating • slow moving test in braking • ambient noise measurements	
11	Repeat points 1-8 for measurement of E-Field (300 MHz – 1000 MHz) • change biconical dipole antenna to log-periodic • ambient noise measurements • measurements at train stationary state • slow moving test in accelerating • slow moving test in braking • ambient noise measurements	
12	Change antenna polarization and repeat points 1-8 for measurement of E-Field (300 MHz – 1000 MHz) • ambient noise measurements • measurements at train stationary state • slow moving test in accelerating • slow moving test in braking • ambient noise measurements	

Table 7: Measurement checklist

8 Test Report

The test report will be submitted with following information.

- Description of site
- Description of measuring system
- Description of railway vehicle (type and configuration)
- Numerical results
- Graphical results
- Weather conditions
- Name of person in charge at site

9 Pass/Fail Criteria

Captured result as per test procedure mentioned in section 7.5 shall be analyzed with limit mentioned in IEC62236-3-1 for 25kV AC OHE Line.

If at specific frequencies or in specific frequency ranges the ambient noise is higher than the limit values less 6 dB, the measurements at these frequencies need not be considered. These frequencies shall be noted in the test report.

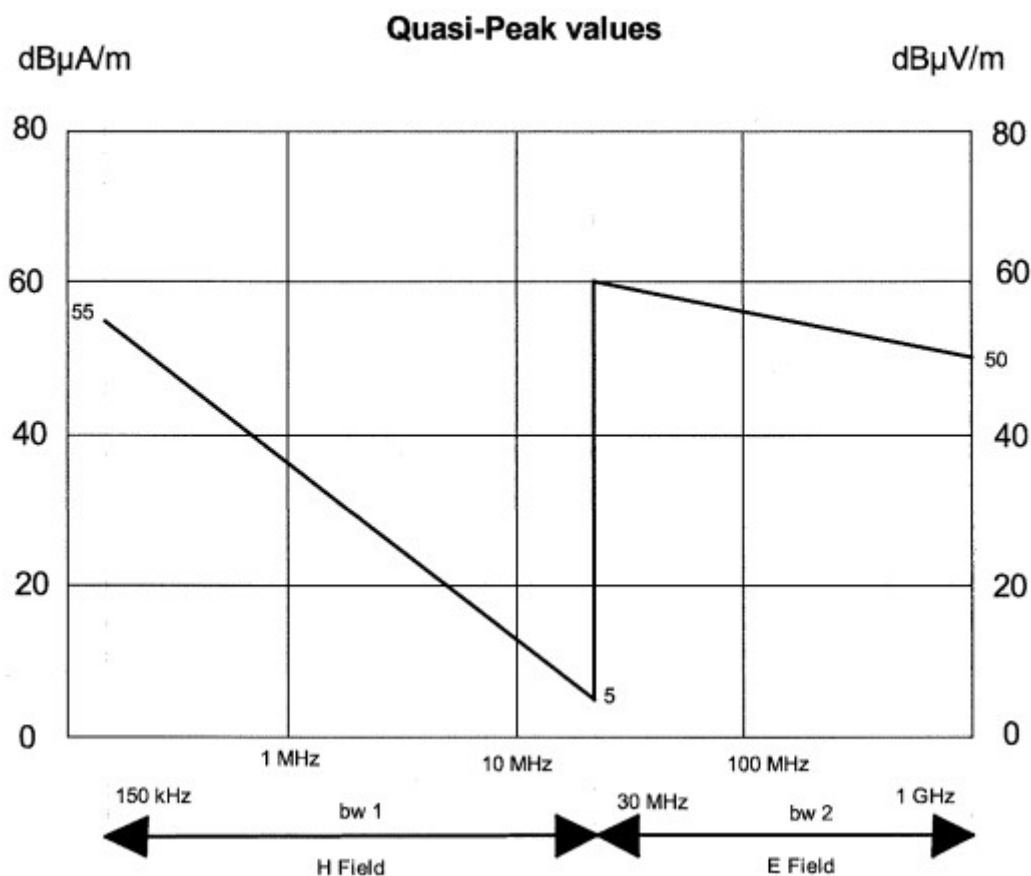


Figure 6: Limit of stationary rake (QP, 10m)

Limit given in figure 6, shall be considered for limit of emission for stationary rake. The limits are defined as quasi-peak values and the bandwidths are those used in EN55016-1-1

Frequencies	Bandwidth
From 150 kHz to 30 MHz	9 kHz
Above 30 MHz	120 kHz

All values are measured at a distance of 10m from the center of the track. The emission limits are specified up to 1 GHz due to the fact that there are no significant sources of interference above 1 GHz and that emissions from microprocessor controlled equipment which may give rise to emissions at frequencies greater than 1 GHz are addressed by compliance with IEC62236-3-2.

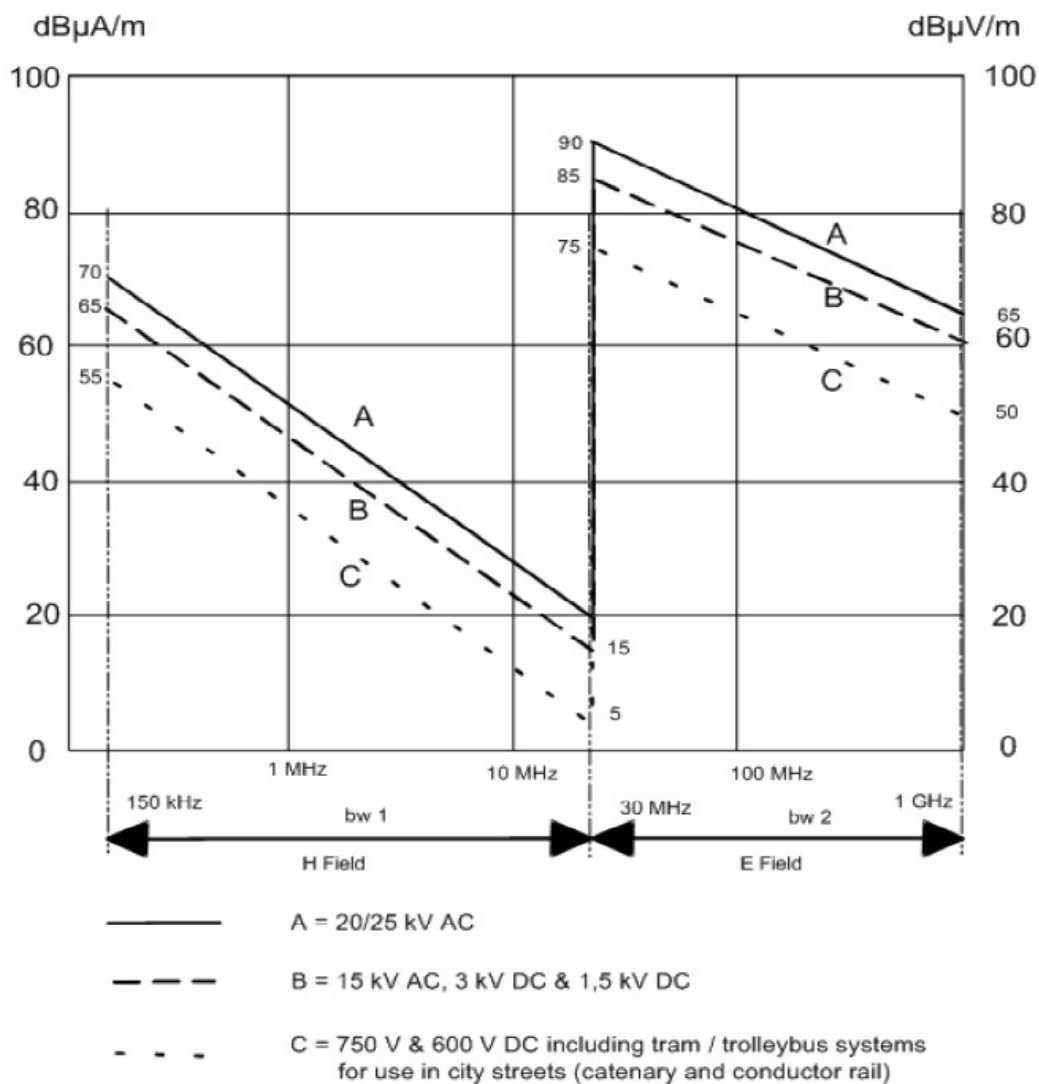


Figure 7: Limit of Moving rake (Peak, 10m)

Limit given in figure 7, Line-A shall be considered for limit of emission for moving rake. Limits are defined as peak value. and the bandwidths are those used in EN55016-1-1

Frequencies	Bandwidth
From 150 kHz to 30 MHz	9 kHz
Above 30 MHz	120 kHz

All values are measured at a distance of 10m from the center of the track. The emission limits are specified up to 1 GHz due to the fact that there are no significant sources of interference above 1 GHz and that emissions from microprocessor controlled equipment which may give rise to emissions at frequencies greater than 1 GHz are addressed by compliance with IEC62236-3-2.