

<div>IVECO</div> <div>Standard</div> <div>TESTING STANDARD</div>		<div>MEASURE OF EMISSIONS RADIATED IN A SEMIANECHOIC CHAMBER BY ELECTRONIC DEVICES INSTALLED ON A VEHICLE</div>		<div>16–2115</div> <div>Page 1/7</div> <div>Date 05.04.2007</div>	
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<div>1PURPOSE</div> <div>Defining test procedure and equipment suitable to test, under all conditions of use, the radiated disturbances emitted to the surrounding environment by electronic systems installed on a vehicle to characterise whether the amount of such disturbances complies to the limits required by the present Standard.</div>					
<div>2SUBJECT</div> <div>The present Standard is valid for apparata installed on vehicles with 12V or 24V system and equipped with internal combustion engine with “Otto” or “Diesel” cycle.</div>					
<div>3GENERAL TEST CONDITIONS</div>					
<div>3.1General</div> <div>The tests must be carried out on systems whose electronic components have already passed the functional checks recalled in the general specification IVECO STD. 18–2252 and in specific specifications.</div>					
<div>3.2Test environment</div> <div>The test place must be free from disturbances that can affect the test results; otherwise, it is necessary to use a semianechoic screened chamber, whose sizes are such as to contain the tested vehicle and the antennas measuring the electromagnetic field. It must have the following characteristics:</div> <div><div>a) minimum screening attenuations with respect to the electromagnetic fields must be:</div><div><div>for electric field100dB from 100kHz to 10GHz 90dB from 10GHz to 18 GHz,</div><div>whereas</div><div>for magnetic field60dB to 10kHz 80dB to 200kHz.</div></div></div>					
Edition	Date	Description of modifications			Group
1	16.07.2001	New.			PEL
2	05.11.2003	Supervisor and Manager added. Modified: points 5.1, 5.3, Table I, point 5.4, Table II, point 6.4 and Table III, plus editing modifications.			
3	22.04.2005	Table III modified.			
4	23.01.2006	Modified: Supervisor and Manager Dept.; point 5.1, 5.3, 6.2, Table III, point 7 and point 8. Point 7.1 added.			
5	21.04.2006	Point 7.1 modified.			
6	05.04.2007	Frequency band changed in Sheets I, II and III (previously was 1000–2200).			
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b) minimum reflection coefficients for anechoic material must be as follows:

- 35dB or better at 200MHz
- 50dB or better at 1GHz
- 40dB at 18GHz.

c) Environmental reference characteristics during the test must be:

- Temperature: $20 \pm 2^{\circ}\text{C}$
- Relative humidity: 45–70%
- Atmospheric pressure: 860–1060 mbar

3.3 Vehicle positioning

The vehicle must be placed within a screened and semianechoic chamber at a distance of 3 or 10 meters from the receiving antenna and at least at 1 meter from sound-absorbing cones, if any.

4 TEST EQUIPMENT

4.1 Receiving antenna

In the frequency band from 30 MHz to 1 GHz, double-cone, log-periodic or double-ridge antennas must be used.

In any case the antenna must be calibrated, together with the used cable (and the adapter device to the measuring instrument, if used), in order to be able to compute the electric field actually measured in dBuV/m. Moreover, it must guarantee such a sensitivity as to allow, combined with measuring instrument performances, the measure of electromagnetic fields whose intensity is by at least 10 dB lower than the limits required in **Table III**.

4.2 Receiver or spectrum analyser

It can be a measuring receiver or a spectrum analyser equipped with preselector; in any case, it must have the following characteristics:

- measuring frequency range: 150kHz to 2.2 GHz;
- sensitivity: at least 10dBuV (equal to –97dBm) at 150 kHz, with bandwidth equal to 10 kHz and with peak detector;
- at least 15dBuV (equal to –92dBm) at 100 MHz, with bandwidth equal to 100 kHz and with peak detector;
- sensitivity: at least –5dBuV (equal to –112dBm) at 150 kHz, with bandwidth equal to 9 kHz and with semi-peak detector;
- input impedance: 50 ohm;
- bandwidth: selectable at least between the following values: 10kHz and 100kHz; in case of use of semi-peak detector, 9kHz and 120kHz;
- detector: peak type, for spectrum analyser;
peak type, with mean value and if required,
semi-peak for measuring receiver.

The detector must have the following rated characteristics:

DETECTOR TYPE	CHARGING TIME CONSTANT (tc)	DISCHARGING TIME CONSTANT (ts)	
		0.15 – 30 MHz	Over 30 MHz
SEMI-PEAK	1 ms	160 ms	550 ms
PEAK	<< 10 µs	1 s (★)	
MEAN VALUE	100 ms	100 ms	

(★) Not applicable in case a spectrum analyser is used.

5 TEST PREPARATION

5.1 Arranging the test equipment

The receiving antenna must be placed according to the available space at:

- 3000 mm height and 10000 + 50 mm distance from vehicle side;

or:

- 1800 mm height and 3000+ 50 mm distance from vehicle side.

Distance is measured from the antenna reference point that corresponds to the antenna center when the double-cone type is used and from the nearest element when using the log-periodic type (including the biconilog ones), or from front opening for conical horn antenna and in any case always with respect to the calibration point.

If they are not stylus antennas, it is necessary to place them both vertically and horizontally.

The tests will have to be carried out on both vehicle sides.

5.2 Test device activation

Activate the device that has to be tested. In some cases the device must be activated by a person inside the cabin while the technician carries out the measure (unless an automation system is available).

The vehicle will only be at key 15 for narrow band tests, while it will be with endothermic engine running at 1500 rpm and idle gearbox for broad band checks.

5.3 Arrangements for measuring Broad Band disturbances

To measure broad band disturbances, use the peak detector (or the semi-peak one). Since limits are expressed in dBµV/m for 120 kHz bandwidth using a semi-peak detector, if using the peak detector, add to the semi-peak limits 38 dB for 1MHz, 20 dB for 120 kHz or subtract 22 dB for 1 kHz to/from values, with reference to limits set at 120 kHz.

In any case, if bandwidth B (expressed in kHz) of the test detector differs from 120 kHz, values in µV/m shall be converted to 120 kHz multiplying them by factor 120/B.

The test must be carried out by using peak detector and bandwidth shown in the appropriate column in **Table I**. When a spectrum analyser is used, the video filter must be adjusted to a value that is equal to at least three times the bandwidth. Alternatively the measure can be carried out with semi–peak detector, in such case by using related bandwidths (**Table I**).

In case of intermittently–operating devices or anyway rarely–operating devices, operate as follows:

- using a measuring receiver, extend the stay time at every frequency to such a value as to allow proper measurement of disturbance envelope;
- using a spectrum analyser, extend the scanning time and/or insert the memory function (“MAX HOLD”) in such a way as to obtain the satisfactory coverage of the displayed spectrum.

TABLE I

Bandwidth, video filter and scanning times for measuring broad band disturbances

Sub–band (MHz)	Bandwidth		Spectrum analyser	
	Peak detector	Semi–peak detector	Video filter	Scanning time
0.15 – 30	9 kHz	9 kHz	30 kHz	100 ms/ MHz
30 – 1000	120 kHz	120 kHz	300 kHz	1 ms/ MHz
1000 – 2500	120 kHz	120 kHz	300 kHz	1 ms/ MHz

5.4 Arrangements for measuring Narrow Band disturbances

To measure narrow band disturbances, use the peak detector (or the average one), keeping the same limits.

The test must be carried out by using bandwidths shown in the appropriate column in **Table II**. Moreover, in order to attenuate broad band disturbances, it is necessary to proceed as follows:

- when a spectrum analyser is used, insert video filter with values shown in the appropriate column in **Table II**;
- when a measuring receiver is used, use mean value detector;
- Set the scanning time (if using the spectrum analyser) or the stay time at each frequency (if using the measuring receiver) to a value high enough to allow proper disturbance envelope measurement. If using the receiver, set a stay time of 100 ms up to 200 MHz and 10 ms for frequencies exceeding 200 MHz. If using the spectrum analyser, the scanning time will be set automatically by the instrument.

During the measure, only activate those tested vehicle devices whose operation provides for the presence of a continuous and repeatable signal, for example units with a fixed frequency clock signal. Therefore, all devices are excluded that operate intermittently or for variable periods of a few seconds and all electromagnetic devices, whose disturbance must be deemed as broad band type.

TABLE II
Bandwidth and video filter for measuring narrow band disturbances

Sub-band (MHz)	Bandwidth Peak or average detector	Video filter (spectrum analyser)
0.15 – 30	9 kHz	100 Hz
30 – 1000	120 kHz	300 Hz
1000 – 2500	120 kHz	300 Hz

6 TEST PROCEDURE

6.1 Background noise

In order to guarantee that the measure is not altered by the ambient electromagnetic noise, it must be repeated with the same modes but deactivating all systems being tested; for every sub-band, the thereby-measured level must be by at least 6 dB lower than the corresponding limit shown in **Table III**.

6.2 Tested device activation

For narrow band tests, the vehicle will be with off thermal engine and key inserted in position 15 of the startup block, in order to guarantee that all components are only supplied and possible disturbances can be generated only by possible oscillators being present in various electronic devices. If devices having oscillators inside them with a frequency < 9kHz are present on the vehicle, such test must not be carried out.

For the broad band test, instead, the vehicle must be with running engine at 1500 rpm, idle gearbox, stopped wheels and activate the devices that has to be tested in such a way as to maximise emissions.

For vehicles with electric drive, the vehicle shall be positioned on passive rollers at 2/3 of top speed.

6.3 Disturbance spectrum measure

In case a measure receiver is used, the whole measuring frequency band must be explored with a pitch that is always less than or equal to the bandwidth.

In case a spectrum analyser is used, the measuring frequency band scanning must be carried out:

- by using sub-bands and minimum scanning times shown in **Table I**, when measuring in broad band;
- according to such sub-bands as to guarantee a distance between samples shown on the instrument display that is lower than or equal to the bandwidth, when measuring narrow band disturbances.

Activate the measuring instrument to carry out the measure and store the results (if possible through automatic acquisition on PC). If possible, previously insert the correction of measured data in instrument or in managing software.

The measure must be carried out by arranging the receiving antenna in vertical and horizontal bias, apart from the case with stylus antennas.
Moreover, it must be carried out on both vehicle sides.

In all measures, the input attenuator of the measuring instrument must be adequately adjusted to correctly display the signal.

In order to check that there are no saturation phenomena on the instrument, repeat the measure after having increased by 10 dB the input attenuation: the absolute level of measured disturbances must remain unchanged within ± 1 dB; otherwise, increase the attenuation until this condition is satisfied and then use this new adjustment to carry out the real measure.

6.4 Acceptability limits for emissions radiated from vehicle systems

Vehicle systems/components must not generate, during their normal operation, radiofrequency disturbances at higher levels than those shown in the following **Table III**, expressed in dBuV/m:

TABLE III
Acceptability limits

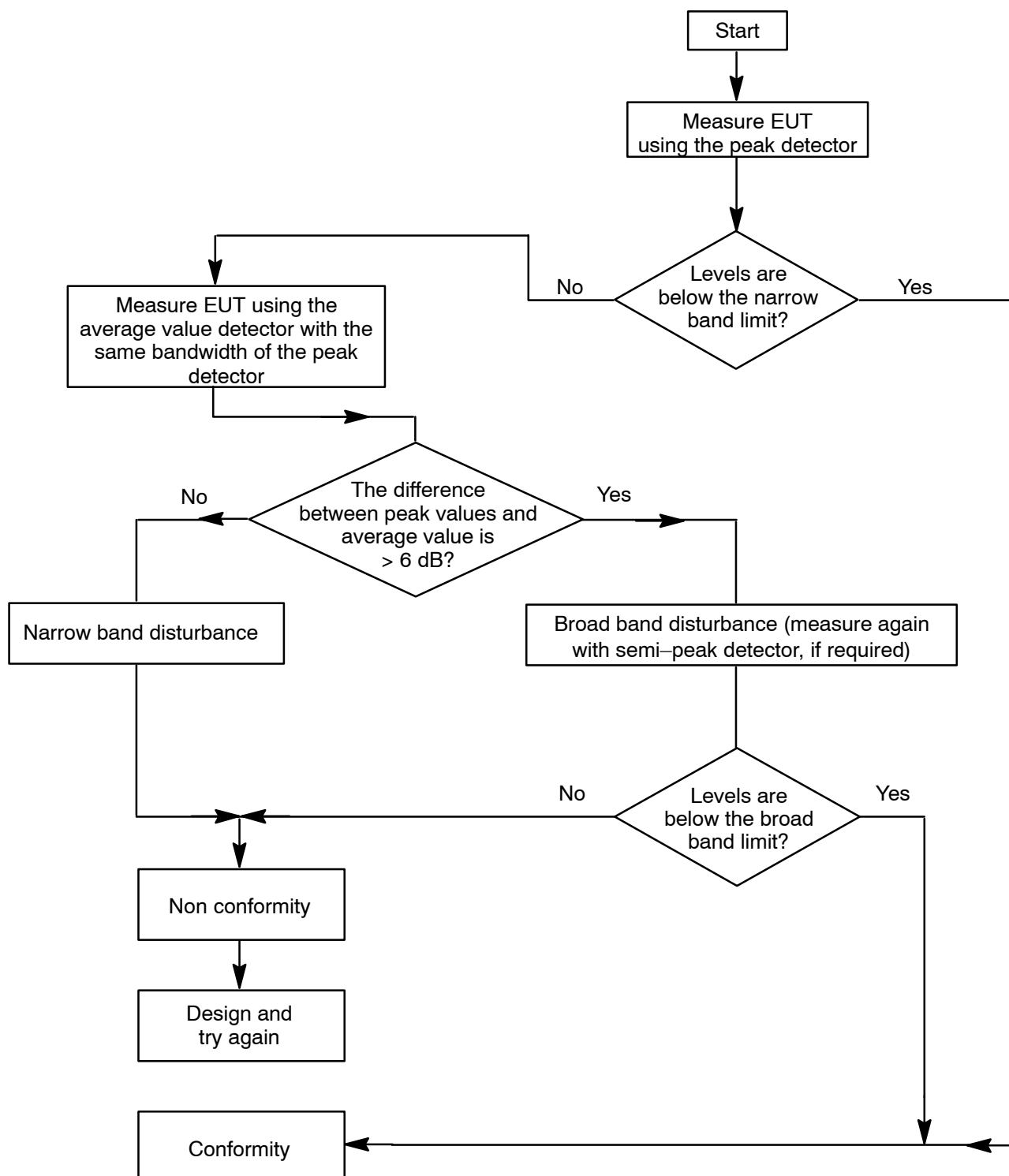
Frequency band (MHz)	Narrow band limits (dBuV/m)		Broad band limits (dBuV/m)			
	Peak or average detector (RBW=120 kHz)		Peak detectors (RBW = 1 MHz)		Semi-peak detectors (RBW = 120 kHz)	
	Antenna distance 3 meters	Antenna distance 10 meters	Antenna distance 3 meters	Antenna distance 10 meters	Antenna distance 3 meters	Antenna distance 10 meters
30 – 75	32	22	62	52	42	32
75 – 400	32+ 15.13 log(f/75)	22+ 15.13 log(f/75)	62+ 15.13 log (f/75)	52+ 15.13 log(f/75)	42+ 15.13 log(f/75)	32+ 15.13 log(f/75)
400 – 1000	43	33	73	63	53	43
1000 – 2500 (★)	43	3	73	63	53	43

(★) Only if explicitly required by Product Specifications.

7 ACCEPTABILITY CRITERIA

Operating conditions of the tested device must be chosen in order to maximise the emissions and must comply with the limits included in **Table III**.

7.1 Method for determining conformity of irradiated disturbances and discrimination between narrow and wide band ones



8 TEST RESULT REPORT

For every system being checked, under any test condition, the measure of radiated disturbances will have to be included in diagrams showing the amount of disturbances being present in the whole test spectrum from 150 kHz to 1 GHz (dB μ V/m – Frequency).

STANDARDS QUOTED

IVECO STD.: 18–2252