AIS-004 (Part 2)

AUTOMOTIVE INDUSTRY STANDARD

Electromagnetic Radiated Immunity of Automotive Vehicles – Requirements and Methods of Tests

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ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

SET-UP BY
MINISTRY OF SHIPPING, ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA

December 2007

Status chart of the Standard to be used by the purchaser for updating the record

Sr. No.	Corr-igenda	Amend-ment	Revision	Date	Remark	Misc.

General remarks:

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the erstwhile Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No.RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the Secretariat of the AIS Committee, has published this standard.

To ensure that the electromagnetic radiations emitted by vehicle and by its various electronic sub-systems does not cause any undue interference with external systems, a standard on the permissible limits of such radiations, AIS-004/1999 already exists and is in force under CMVR w.e.f. 1st July 2003. With the advancement of automotive technology electronic content in automotive vehicles, especially in engine control, braking control is increasing. Hence a need is felt to formulate requirements of immunity of vehicles and their electronic sub-systems to external electromagnetic radiations from e.g. Radio / TV / Mobile Transmitters. Hence AIS-004 (Part 2) "Electromagnetic Radiated Immunity of Automotive Vehicles – Requirements and Methods of Tests" is prepared by the panel constituted by AISC.

While preparing this AIS considerable assistance is derived from following ECE regulation and EEC Directive:

ECE R 10 (Rev.2, Amd 2)(Supp.2 to 02 series of Amendment, Date of entry into force Aug. 12, 2004)((Issue: 3 Oct/2004) : Uniform provisions concerning the Approval of Vehicles with regard to Electromagnetic Compatibility

Commission Directive 2004/104/EC (Oct. 14, 2004) : adapting to technical progress Council Directive 72/245/EEC relating to the Radio Interference (Electromagnetic Compatibility) of vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member states relating to type-approval of motor vehicles and their trailers.

The Automotive Industry Standards Committee responsible for preparation of this standard is given in Annex: 5

Electromagnetic Radiated Immunity of Automotive Vehicles - Requirements and Methods of Tests

1. SCOPE

This standard applies to the electromagnetic radiated immunity of automotive vehicles and to components or separate electrical / electronic technical units intended for fitment in vehicles.

2. PURPOSE

This standard lays down the requirements and methods of tests for determinining electromagnetic radiated immunity of automotive vehicles and separate electrical/electronic technical units intended for fitment in vehicles.

3. APPLICATION

This standard applies to all types of motor vehicles, including agricultural tractors. This also applies to electric vehicle or vehicles fitted with electric traction motors and to components or separate technical units intended for fitment in vehicles.

4. DEFINITIONS

For the Purposes of this standard following definitions shall apply:

4.1 '**Electromagnetic Compatibility'** means the ability of a vehicle or component(s) or separate electrical/electronic technical units(s) to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

4.2 '**Electromagnetic Immunity**' means the ability of a vehicle or component(s) or separate technical unit(s) to perform without degradation of performance in the presence of specified electromagnetic disturbances.

5. TYPE APPROVAL - APPROVAL OF A VEHICLE TYPE

5.1 The vehicle manufacturer shall draw up a schedule describing all projected combinations of relevant vehicle electronic/electrical systems, or separate technical units, body styles, variations in body material, general wiring arrangement, engine variations, left hand/ right hand versions and wheel base versions. Relevant vehicle electrical / electronic systems or ESAs are those which are involved in immunity related functions of the vehicle. The driver's direct control of the vehicle is exercised by means of for example, steering, braking or engine speed control.

The immunity related functions of vehicle are:

(a) Functions related to the direct control of the vehicle:
  (i) by degradation or change in: e.g. engine, gear, brake, suspension, active steering, speed limitation devices;
  (ii) by affecting driver's position: e.g. seat or steering wheel positioning;
  (iii) by affecting driver's visibility: e.g. dipped beam, windscreen wiper.

(b) Functions related to driver, passenger and other road user protection:
(i) e.g. airbag and safety restraint systems.

(c) Functions which when disturbed cause confusion to the driver or other road users:
(i) optical disturbances: incorrect operation of e.g. direction indicators, stop lamps, end outline marker lamps, rear position lamp, light bars for emergency system, wrong information from warning indicators, lamps or displays related to functions in subparagraphs (a) or (b) which might be observed in the direct view of the driver;
(ii) acoustical disturbances: incorrect operation of e.g. anti-theft alarm, horn.

(d) Functions related to vehicle data bus functionality:
(i) by blocking data transmission on vehicle data bus-systems, which are used to transmit data, required to ensure the correct functioning of other immunity related functions.

(e) Functions which when disturbed affect vehicle statutory data: e.g. tachograph, odometer.

5.2 Type approval of a vehicle

The following alternative routes to type-approval of a vehicle may be used at the discretion of the vehicle manufacturer.

5.2.1 Approval of vehicle installation

A vehicle installation may achieve type approval directly by following the provisions laid down in paragraph 6. If this route is chosen by a vehicle manufacturer, no separate testing of electrical/electronic systems or ESAs is required.

5.2.2 Approval of vehicle type by testing of individual ESAs.

A vehicle manufacturer may obtain approval of the vehicle by demonstrating to the testing agency that all the relevant (see Para 5.1) electrical/electronic systems or ESAs have been individually approved in accordance with this standard and have been installed in accordance with any conditions attached thereto.

5.2.3 A manufacturer may obtain approval if the vehicle has no equipment of the type which is subject to immunity tests. The vehicle shall have no systems as specified in paragraph 5.1. Such approvals do not require testing.

5.3 Type approval of an ESA

An ESA may achieve type approval by following the provisions laid down in paragraph 6. Type approval may be granted to an ESA to be fitted either to any vehicle type or to a specific vehicle type or types as requested by the manufacturer. ESAs involved in the direct control, as explained in 5.1, of vehicles will normally receive type approval in conjunction with applicable vehicle.

5.4 Guidelines for deciding applicability of radiated immunity test, Worst Case Criteria (WCC) and criteria for Extension of Approval (CEA) shall be as per Annex 3.

5.5 Conformity of Production Procedures of a Vehicle fitted with ESA

5.5.1 A vehicle approved under this standard shall be so manufactured as to conform to the type approved by meeting the relevant requirements set forth in this standard.

5.5.2 Whole vehicle conformity of production procedures shall be applicable as and when notified by the Government (Ministry of Shipping, Road Transport & Highways).

5.6 Conformity of Production Procedures of an ESA

5.6.1 ESA approved under this standard shall be so manufactured as to conform to the type approved by meeting the relevant requirements set forth in this standard.

5.6.2 Conformity of production procedures as and when notified by the Government (Ministry of Shipping, Road Transport & Highways) in AIS-037 shall be applicable

6. REQUIREMENTS

6.1 For Vehicles

This test is intended to demonstrate the immunity to degradation in the direct control of the vehicle. The vehicle shall be subjected to electromagnetic fields as described in Annex.1. The vehicle shall be monitored during the test.

If tests are made using the method described in Annex.1, the field strength reference limit shall be 24V/m r.m.s. in over 90% of the 20 MHz to 1000 MHz frequency band and 20V/m r.m.s. over the whole 20 MHz to 1000 MHz frequency band.

The test vehicle shall be considered as conforming to immunity requirements if during the test performed in accordance with Annex.1 and subjected to a field strength expressed in V/m of 25% above the reference level, no abnormal change in the speed of the driving wheels of the vehicle, no degradation of performance which would cause confusion to other road users and no degradation in the driver's direct control of the vehicle can be observed by the driver or other road users. The driver's direct control of the vehicle is exercised by means of, for example, steering, braking or engine speed control.

6.2 For Electronic Sub-Assemblies (ESA)

The ESA shall be tested for the requirements of immunity as per Annex.2.

If tests are made using the methods described in Annex.2, the immunity test reference levels shall be 48 V/m for 150 mm stripline testing method, 12 V/m for 800 mm stripline testing method, 60 V/m for the TEM cell testing method, 48 mA for the bulb current injection (BCI test method) and 24 V/m for the free-field test method.

The ESA shall be considered as conforming to immunity requirements if during the tests performed in accordance with Annex.2 and subjected to field strength or current, expressed in appropriate linear units, 25% above the reference limit, the ESA shall not exhibit any mal-function which would cause any degradation of performance which would cause confusion to other road users or any degradation in the driver's direct control of a vehicle fitted with the system.

6.3 Exceptions

6.3.1 Vehicles which do not have electrical/electronic system with "immunity related functions " need not be tested for immunity and shall be deemed to conform to paragraph 6.1 above and Annex 1.

6.3.2 ESAs with no "immunity related functions" of the vehicle need not be tested for immunity and shall be deemed to conform to paragraph 6.2 above and Annex 2.

7.0 Application for Approval

The application for approval shall be submitted by vehicle/ESA manufacturer or by his duly accredited representative.

Information to be submitted by vehicle / ESA manufacturer at the time of applying for type approval shall be as given in Annex 4A and 4B respectively.

8.0 Changes in Technical Specifications

8.1 Every modification pertaining to the information, even if the changes are not technical in nature declared in accordance with 7.0, shall be intimated by the manufacturer to the certifying agency.

If the changes are in parameters not related to the provisions, no further action will be taken.

If the changes are in parameters related to the provisions, the testing agency which has issued the certificate of compliance shall then consider whether

8.1.1 The model with the changed specifications still complies with provisions or

8.1.2 Any further verification is required to establish compliance.

8.2 For considering whether testing is required or not, guidelines given in para 5.4 (criteria for extension of approval) shall be used.

8.3 In case of 8.1.2, tests for only those parameters which are affected by the modifications need be carried out.

8.4 In case of fulfilment of criterion of para 8.1.1, or after results of further verification as per para 8.1.2 are satisfactory, the approval of compliance shall be extended for the changes carried out.

ANNEX 1
(see 6.1)
METHOD OF TESTING IMMUNITY OF VEHICLES TO ELECTROMAGNETIC RADIATION

1. GENERAL

1.1. The test method described in this Annex shall only be applied to vehicles.

1.2. Test Method

This test is intended to demonstrate the immunity to degradation in the direct control of the vehicle. The vehicle shall be subjected to electromagnetic fields as described in this Annex. The vehicle shall be monitored during the tests.

2. EXPRESSION OF RESULTS

For the test described in this Annex, field strengths shall be expressed in Volts/m.

3. MEASURING LOCATION

The test facility shall be capable of generating electromagnetic field strengths over the frequency ranges defined in this Annex. The test facility shall conform to national legal requirements regarding the emission of electromagnetic signals.

Care shall be taken so that the control and monitoring equipment shall not be affected by radiated fields in such a way as to invalidate the tests.

4. VEHICLE STATE DURING TESTS

4.1 The vehicle shall be in an unladen condition except for necessary test equipment.

4.1.1 The engine shall normally turn the driving wheels at a steady speed of 50 km/h, or 25 km/h in the case of L1, L2 and L5 vehicles (refer AIS-053), if there is no technical reason for a manufacturer to prefer a different speed. The vehicle shall be on an appropriately loaded dynamometer or alternatively supported on insulated axle stands with minimum ground clearance if no dynamometer is available. Where appropriate, transmission shafts may be disconnected (e.g. trucks, two and three wheeler vehicles).

4.1.2 All equipment which can be switched on permanently by the driver or passenger should be in normal operation.

4.1.3. All other systems which affect the driver's control of the vehicle shall be on as in normal operation of the vehicle.

4.1.4 The vehicle shall not be electrically connected to the test area and no connections shall be made to the vehicle from any equipment, except as required by paragraph 4.1.1 or 4.2. Tyre contact with the test area floor shall not be considered to be an electrical connection.

4.2. If there are electrical/electronic systems forming an integral part of the direct control of the vehicle, which will not operate under the conditions described in paragraph 4.1.1, it shall be permissible for the manufacturer to provide a report or additional evidence to the testing authority that the vehicle electrical/electronic systems meet the requirements of this Standard. Such evidence shall be attached to the type approval application.

4.3. Only non-perturbing equipment shall be used while monitoring the vehicle. The vehicle exterior and the passenger compartment shall be monitored to determine whether the requirements of this Annex are met (e.g. by using (a) video camera(s), a microphone etc.).

4.4. The vehicle shall normally face a fixed antenna. However, where the electronic control units and the associated wiring harness are predominantly in the rear of the vehicle, the test should normally be carried out with the vehicle facing away from the antenna. In the case of long vehicles (i.e. excluding cars and light vans), which have electronic control units and associated wiring harness predominantly towards the middle of the vehicle, a reference point (See paragraph 5.4 of this Annex) may be established based on either the right side surface or the left side surface of the vehicle. This reference point shall be at the midpoint of the vehicle's longitudinal axis or at a point along the side of the vehicle chosen by the manufacturer in conjunction with the competent authority after considering the distribution of electronic systems and the layout of any wiring harness. Such testing may take place only if the geometric dimensions of the chamber permit. The antenna location must be noted in the test report.

5. FIELD GENERATING DEVICE TYPE, POSITION AND ORIENTATION

5.1. Field Generating Device Type

5.1.1. The field generating device type(s) shall be chosen so that the desired field strength is achieved at the reference point (See paragraph 5.4 of this Annex) at the appropriate frequencies.

5.1.2. The field generating device(s) may be one or more antenna(s) or a transmission line system (TLS).

5.1.3. The construction and orientation of any field generating device shall be such that the generated field is polarised from 20 to 1,000 MHz horizontally or vertically

5.2. Height and Distance of Measurement

5.2.1. Height

5.2.1.1 The phase centre of any antenna shall not be less than 1.5 m above the plane on which the vehicle rests or not less than 2.0 m above the plane on which the vehicle rests if the vehicle roof exceeds 3 m in height.

5.2.1.2 No part of any antenna's radiating elements shall be closer than 0.25 m to the plane on which the vehicle rests.

5.2.2 Distance of Measurement

5.2.2.1 In-service conditions may be best approximated by placing the field generating device as far from the vehicle as practical. This distance will typically lie within the range 1 to 5 m.

5.2.2.2 If the test is carried out in an enclosed facility, the field generating device's radiating elements shall be no closer than 1.0 m to any radio absorbent material and no closer than 1.5 m to the wall of the enclosed facility. There shall be no absorbent material between the transmitting antenna and the vehicle under test.

5.3 Antenna Location Relative to Vehicle

5.3.1 The field generating device's radiating elements shall not be closer than 0.5 m to the outer body surface of the vehicle.

5.3.2 The field generating device shall be positioned on the vehicle's centre line (plane of longitudinal symmetry).

5.3.3 No part of a TLS, with the exception of the plane on which the vehicle rests, shall be closer than 0.5 m to any part of the vehicle.

5.3.4 Any field generating device which is placed over the vehicle shall extend centrally over at least 75 % of the length of the vehicle.

5.4 Reference Point

5.4.1 For the purposes of this Annex, the reference point is the point at which the field strength shall be established and shall be defined as follows:

5.4.1.1 at least 2 m horizontally from the antenna phase centre or at least 1 m vertically from the radiating elements of a TLS,

5.4.1.2 on the vehicle's centre line (plane of longitudinal symmetry),

5.4.1.3 at a height of 1.0 ± 0.05 m above the plane on which the vehicle rests or 2.0 ± 0.05 m if the minimum height of the roof of any vehicle in the model range exceeds 3.0 m,

5.4.1.4 either:

1.0 ± 0.2 m inside the vehicle, measured from the point of intersection of the vehicle windscreen and bonnet (Point C in Appendix 1 to this Annex),

or:

0.2 ± 0.2 m from the centre line of the foremost axle of the vehicle measured towards the centre of the vehicle (Point D in Appendix 2 to this Annex), whichever results in a reference point closer to the antenna.

or:

at 1.0 ± 0.2 m behind the vertical centreline of the vehicle's front wheel (Point C in Appendix 3 to this Annex) in the case of three-wheeled vehicles,

or:

at 0.2 ± 0.2 m behind the vertical centreline of the vehicle's front wheel (Point D in Appendix 4 to this Annex) in the case of two-wheeled vehicles.

5.5 If it is decided to radiate the rear of the vehicle, the reference point shall be established as in paragraph 5.4. The vehicle shall then be installed facing away from the antenna and positioned as if it had been horizontally rotated 180 around its centre point, i.e. such that the distance from the antenna to the nearest part of the outer body of the vehicle remains the same. This is illustrated in Appendices 5 and 6 to this Annex as appropriate for the Category of vehicle.

6. TEST REQUIREMENTS

6.1 Frequency range, dwell times, polarization

The vehicle shall be exposed to electromagnetic radiation in the 20 to 1,000 MHz frequency range.

6.1.1 To confirm that the vehicle meets the requirements of this Annex, the vehicle shall be tested at up to 14 spot frequencies in the range, e.g.: 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750 and 900 MHz. The response time of the equipment under test shall be considered and the dwell time shall be sufficient to allow the equipment under test to react under normal conditions. In any case, it shall not be less than 2 seconds.

6.1.2 One mode of polarisation shall be used at each frequency - See paragraph 5.1.3.

6.1.3 All other test parameters shall be as defined in this Annex.

6.1.4 If a vehicle fails the test defined in paragraph 6.1.1 of this Annex, it must be verified as having failed under the relevant test conditions and not as a result of the generation of uncontrolled fields.

7. GENERATION OF REQUIRED FIELD STRENGTH

7.1. Test Methodology

7.1.1. The "substitution method" shall be used to obtain the necessary test field strength.

7.1.2. Calibration Phase

At each test frequency, a level of power shall be fed into the field generating device to produce the required field strength at the reference point (as defined in paragraph 5) in the test area with the vehicle absent, the level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded. Test frequencies shall lie in the range 20 to 1,000 MHz. Calibration shall be made, starting at 20 MHz, in steps not greater than 2 % of the previous frequency finishing at 1,000 MHz. These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated.

7.1.3. Test Phase

The vehicle shall then be introduced into the test facility and positioned in accordance with the requirements of paragraph 5. The required forward power defined in paragraph 7.1.2 shall then be applied to the field generating device, in accordance with paragraph 6.1.1.

7.1.4. Whatever parameter is chosen in paragraph 7.1.2 to define the field, the same parameter shall be used to establish the field strength during the test.

7.1.5. The field generating equipment and its layout employed during the test shall be to the same specification as that used during the operations described in paragraph 7.1.2.

7.1.6. Field Strength Measuring Device

A suitable compact field strength measuring device shall be used to determine the field strength during the calibration phase.

7.1.7. During the calibration phase, the phase centre of the field strength measuring device shall be positioned at the reference point.

7.1.8. If a calibrated receiving antenna is used as the field strength measuring device, readings shall be obtained in three mutually orthogonal directions and the isotropic equivalent value of the readings shall be taken as the field strength.

7.1.9. To take account of different vehicle geometries, a number of antennae positions or reference points may need to be established for a given test facility.

7.2. Field Strength Contour

7.2.1. During the calibration phase (prior to a vehicle being introduced into the test area), the field strength in at least 80 % of the calibration frequencies shall not be less than 50 % of the nominal field strength, at the following locations:

(i) for all field generating devices 0.5 ± 0.05 m either side of the reference point on a line passing through the reference point and at the same height as the reference point, and perpendicular to the vehicle plane of longitudinal symmetry;

(ii) in the case of a TLS, 1.50 ± 0.05 m on a line passing through the reference point at the same height as the reference point and along the line of longitudinal symmetry.

7.3. Chamber Resonance

Where the conditions described in paragraph 7.2.1 above are not met, tests shall not be performed at chamber resonance frequencies.

7.4. Characteristics of the Test Signal to be Generated

7.4.1. Maximum Envelope Excursion

The maximum envelope excursion of the test signal shall equal the maximum envelope excursion of an unmodulated sine wave whose r.m.s. value in Volts/m is defined in Clause 6.1of this standard.

7.4.2. Test Signal Wave Form

The test signal shall be a radio frequency sine wave, amplitude modulated by a 1 kHz sine wave at a modulation depth m of 0.8 ± 0.04.

7.4.3. Modulation Depth

The modulation depth m is defined as:

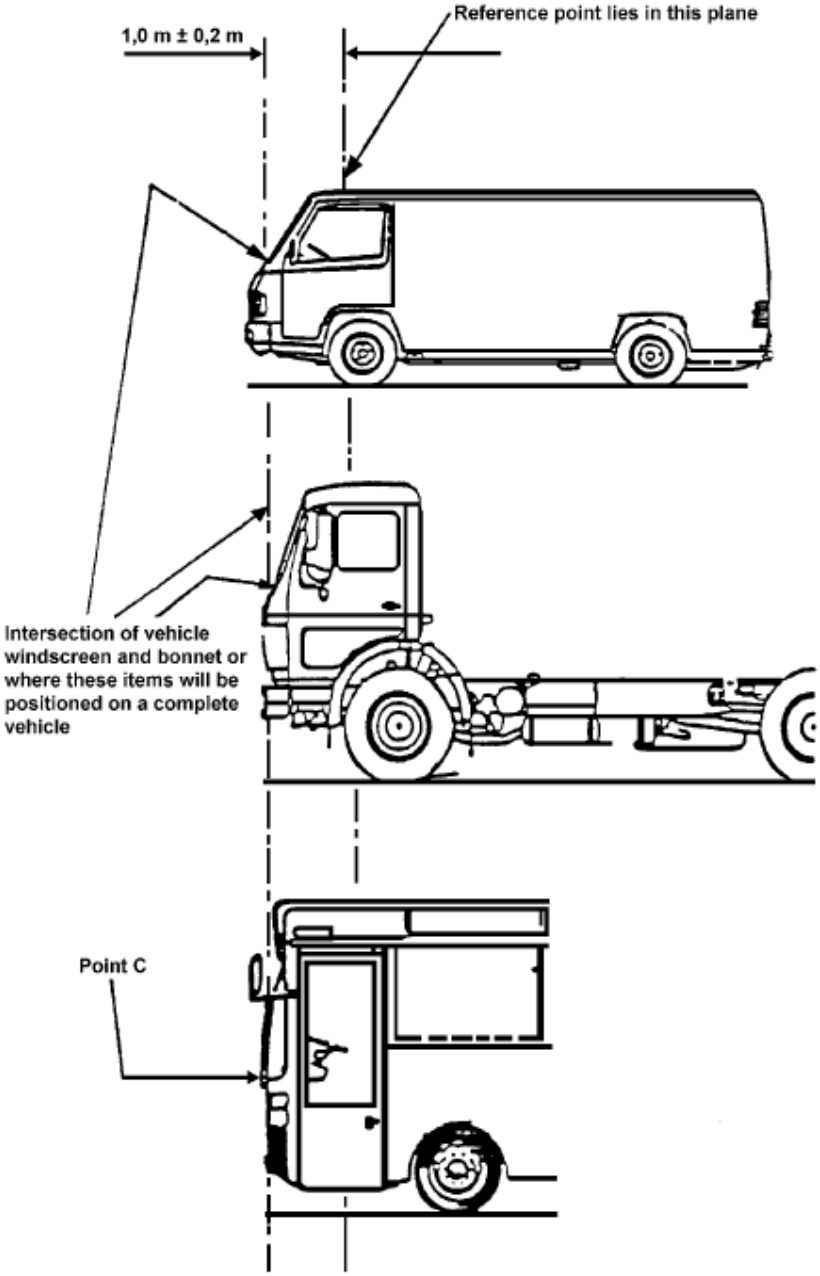
$$m = \frac{\text{Maximum Envelope Excursion- Minimum Envelope Excursion}}{\text{Maximum Envelope Excursion + Minimum Envelope Excursion}}$$

8. VEHICLE TEST CONDITIONS AND ACCEPTANCE / FAILURE CRITERIA

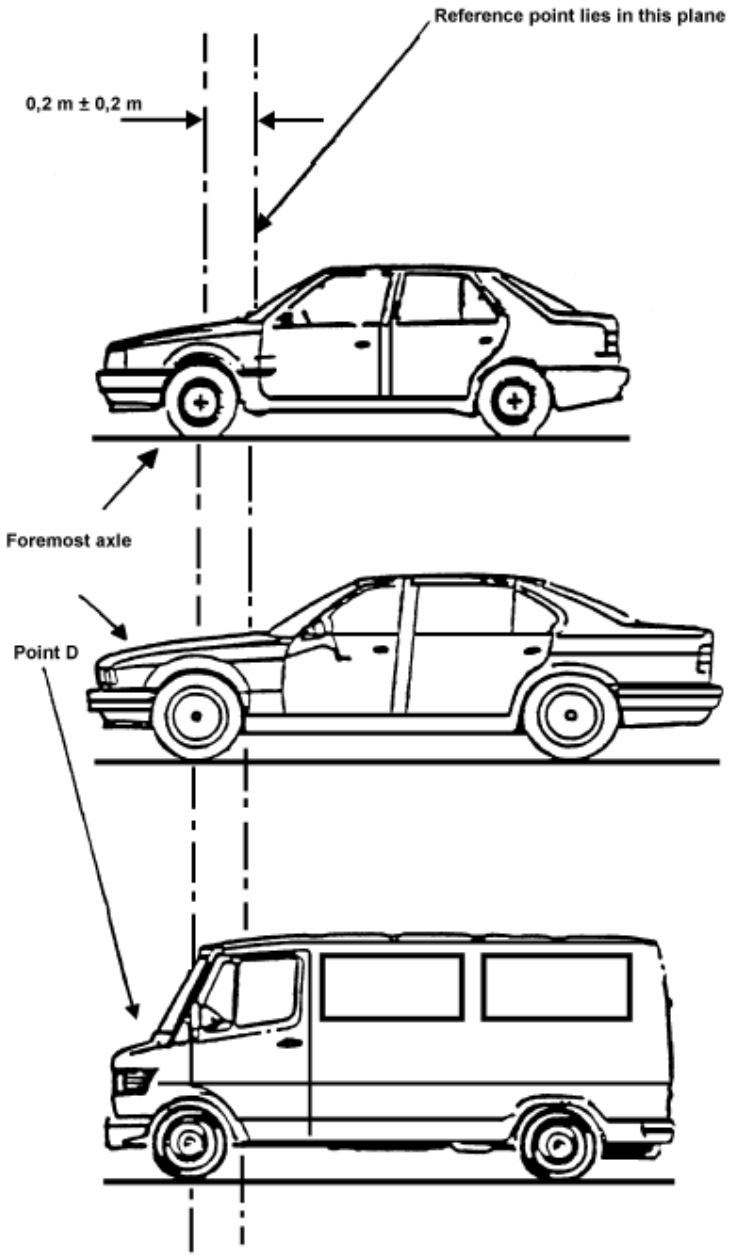
This paragraph defines minimum vehicle test conditions (as far as applicable) and failure criteria for vehicle immunity tests. Other vehicle systems, which can affect immunity related functions must be tested in a way to be agreed between manufacturer and test agency.

Vehicle Test Condition	Failure Criteria
Vehicle speed 50 km/h (respectively 25 km/h for L1, L2 and L5 vehicles) ± 20 % (vehicle driving the rollers). If the vehicle is equipped with a cruise control system, it shall be operational	Speed variation greater than ± 10% of the nominal speed. In case of automatic gearbox: change of gear ratio inducing a speed variation greater than ± 10 % of the nominal speed
Dipped beams ON (manual mode)	Lighting OFF
Front wiper ON (manual mode) maximum speed	Complete stop of front wiper
Direction indicator on driver's side ON	Frequency change (lower than 0.75 Hz or greater than 2.25 Hz) Duty cycle change (lower than 25 % or greater than 75 %)
Adjustable suspension in normal position	Unexpected significant variation
Driver's seat and steering wheel in medium position	Unexpected variation greater than 10 % of total range
Alarm unset	Unexpected activation of alarm
Horn OFF	Unexpected activation of horn
Airbag and safety restraint systems operational with inhibited passenger airbag if this function exists	Unexpected activation
Automatic doors closed	Unexpected opening
Adjustable endurance brake lever in normal position	Unexpected activation
Operation of the brake pedal	Stop lights inactivated during cycle Brake warning light ON with loss of function Unexpected activation

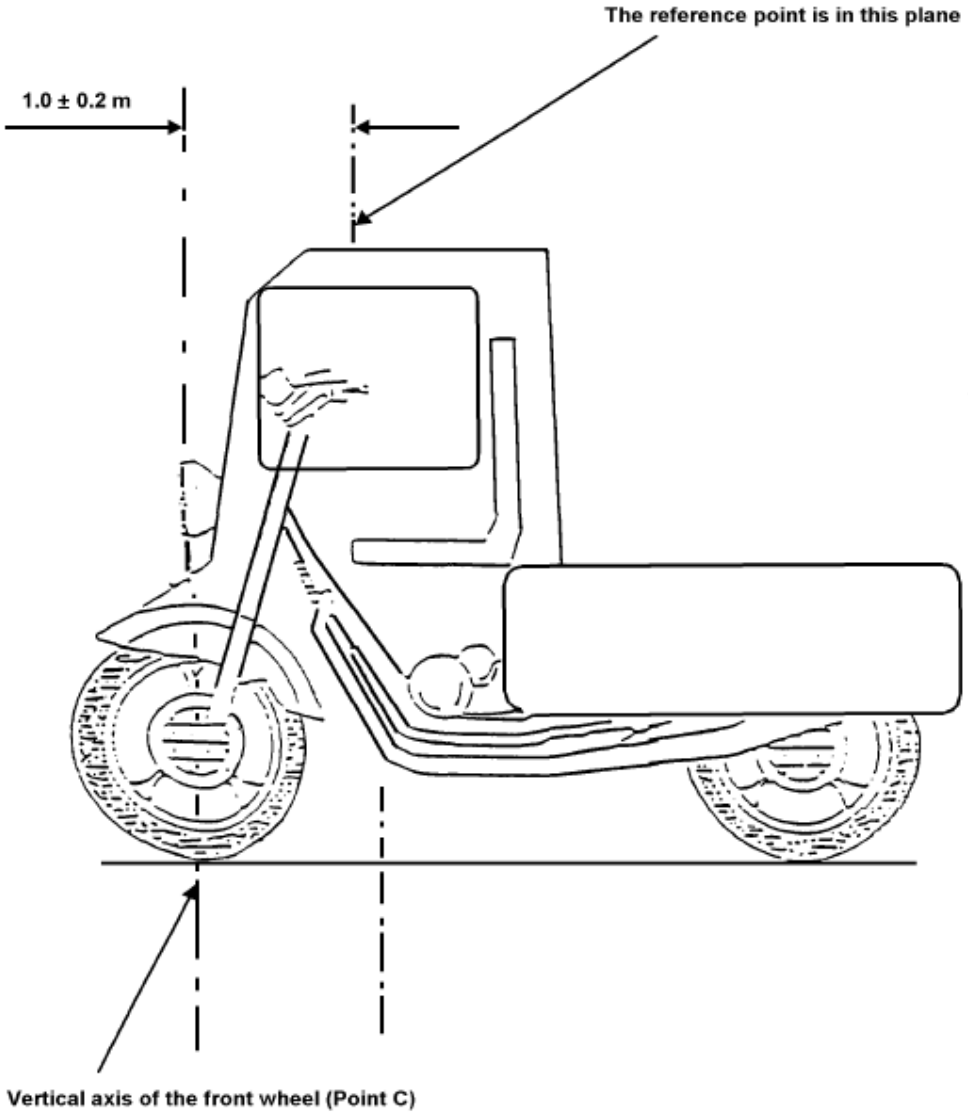
ANNEX 1 - APPENDIX 1



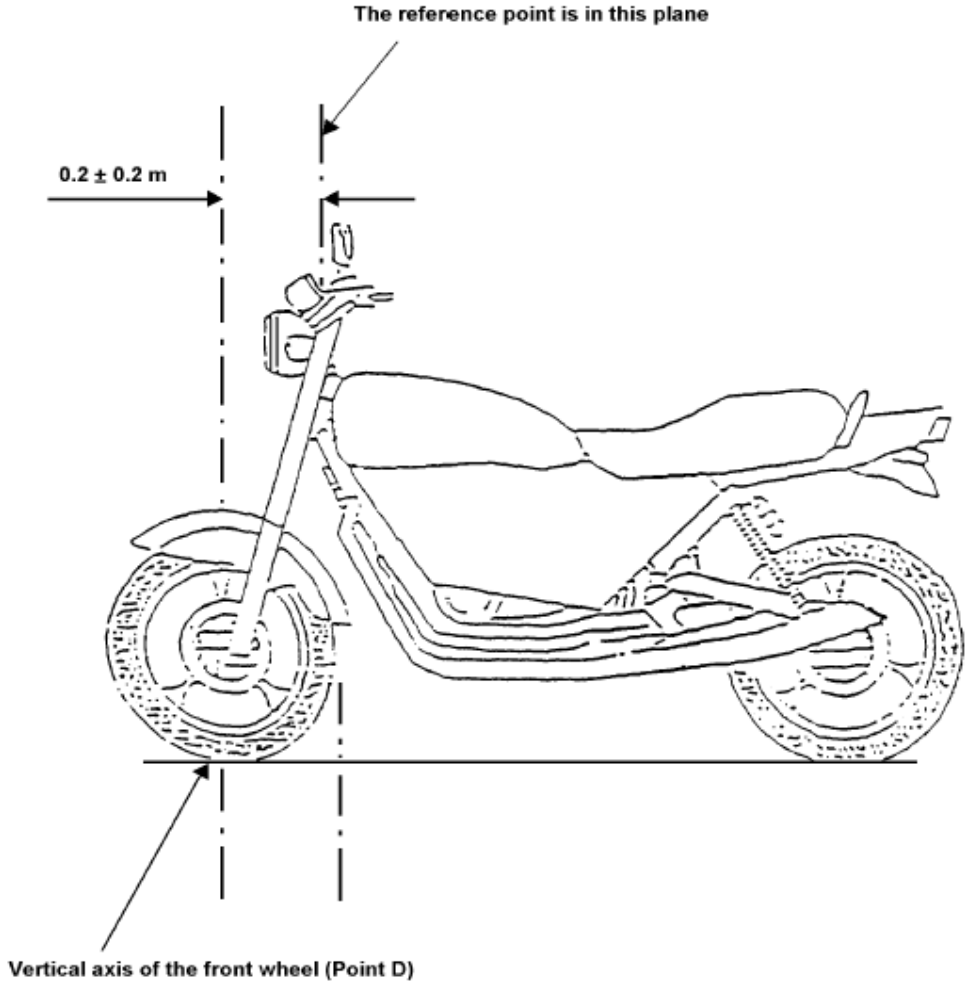
ANNEX 1 - APPENDIX 2



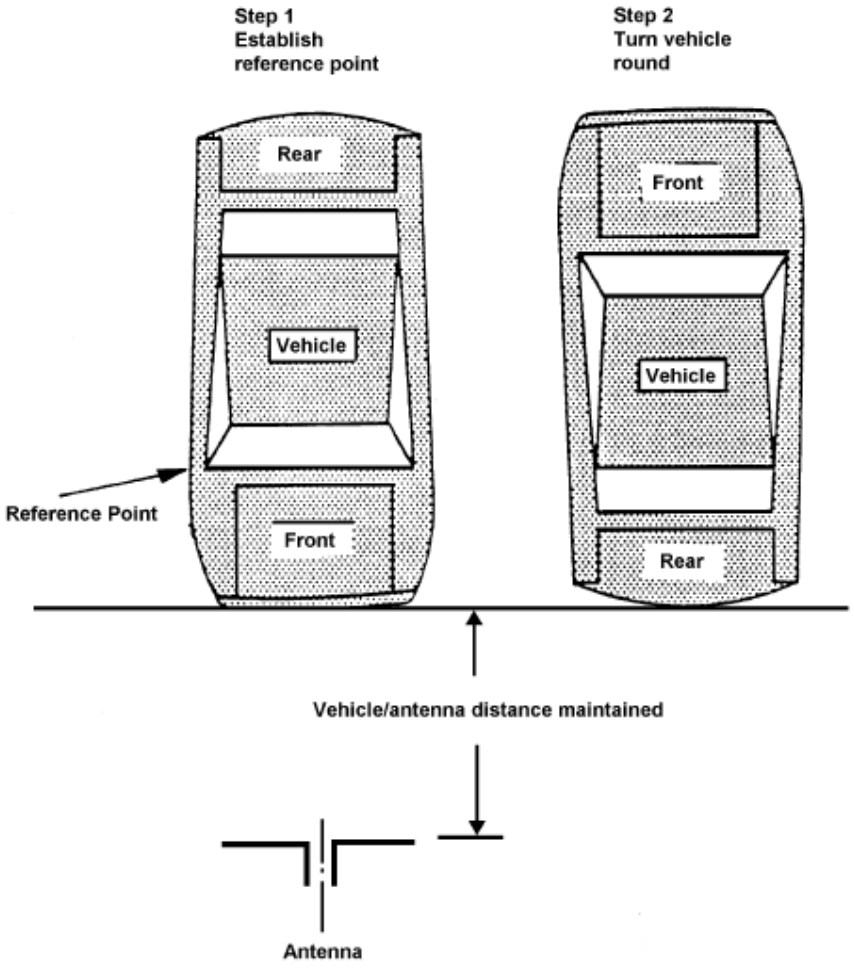
ANNEX 1 - APPENDIX 3



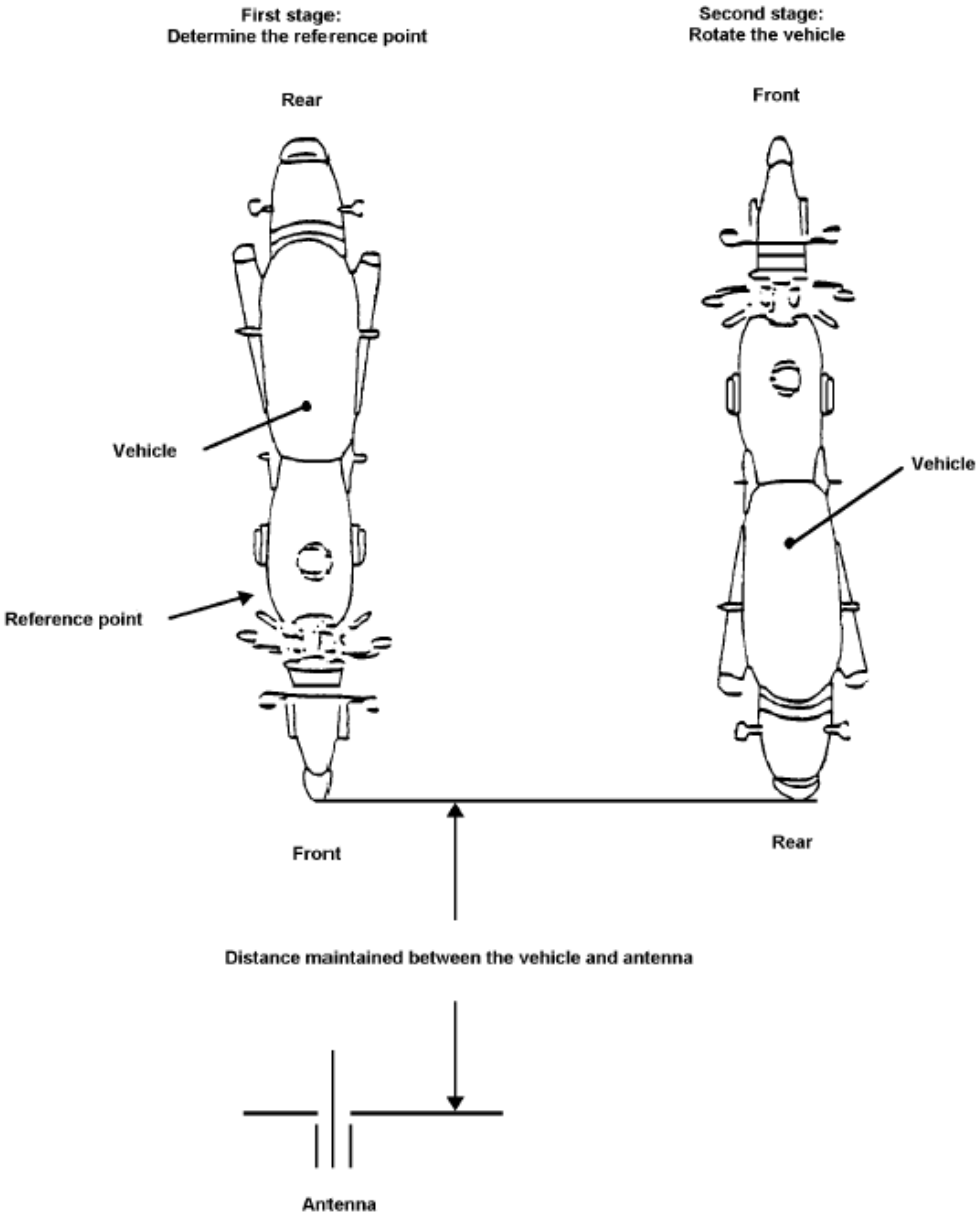
ANNEX 1 - APPENDIX 4



ANNEX 1 - APPENDIX 5

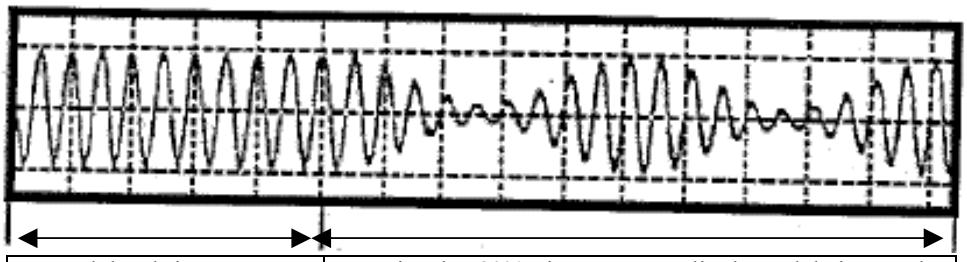


ANNEX 1 - APPENDIX 6



ANNEX 1 - APPENDIX 7

CHARACTERISTICS OF SIGNAL TO BE GENERATED



Unmodulated sine wave with r.m.s. value as defined in para 6.1 of this standard	Test signal at 80%, sine wave, amplitude modulation; peak envelope excursion equal to peak excursion of unmodulated sine wave with r.m.s. as defined in para 6.1 of this standard

ANNEX 2
(see 6.2)

METHOD OF TESTING IMMUNITY OF ELECTRICAL/ELECTRONIC SUB-ASSEMBLIES TO ELECTROMAGNETIC RADIATION

1. GENERAL

1.1 The test methods described in this Annex shall be applied to ESAs.

1.2 Test Methods

1.2.1 ESAs may conform to the requirements of any combination of the following test methods, provided that this results in the full frequency range specified in paragraph 5.1 of this Annex being covered.

1.2.1.1 Stripline test: See Appendix 1 to this Annex

1.2.1.2 Bulk current injection test: See Appendix 2 to this Annex

1.2.1.3 TEM cell test: See Appendix 3 to this Annex

1.2.1.4 Free field test: See Appendix 4 to this Annex

1.2.2 Due to radiation of electromagnetic fields during these tests, all testing shall be conducted in a shielded area.

2. EXPRESSION OF RESULTS

For the tests described in this Annex, field strengths shall be expressed in Volts/m and injected current shall be expressed in milliAmps.

3. MEASURING LOCATION

3.1 The test facility shall be capable of generating the required test signal over the frequency ranges defined in this Annex. The test facility shall conform to (national) legal requirements regarding the emission of electromagnetic signals

3.2 The measuring equipment shall be located outside the chamber.

4. STATE OF ESA DURING TESTS

4.1 The ESA under test shall be in normal operation mode. It shall be arranged as defined in this Annex unless individual test methods dictate otherwise.

4.2 Power shall be applied to the ESA under test via an (5µH/50 ohm) artificial network (AN), which shall be electrically grounded. The electrical supply voltage shall be maintained to ± 10 % of its nominal system operating voltage. Any ripple voltage shall be less than 1.5 % of the nominal system operating voltage measured at the AN monitoring port.

4.3 Any extraneous equipment required to operate the ESA under test shall be in place during the calibration phase. No extraneous equipment shall be closer than 1 m from the reference point during calibration.

4.4 To ensure reproducible measurement results are obtained the tests signal generating equipment and its layout shall be to the same specification as that used during each appropriate calibration phase (paragraphs 7.2, 7.3.2.3, 8.4, 9.2 and 10.2 of this Annex).

4.5 If the ESA under test consists of more than one unit, the vehicle wiring harness should preferably be used. If these are not available, the length between the electronic control unit and the AN shall be 1,500 ± 75 mm. All cables in the loom should be terminated as realistically as possible and preferably with real loads and actuators.

5. FREQUENCY RANGE, DWELL TIMES

5.1 Measurements shall be made in the 20 to 1,000 MHz frequency range.

5.2 To confirm that the ESAs meet the requirements of this Annex, the tests shall be performed at up to 14 spot frequencies in the range, e.g.: 27, 45, 65, 90, 120, 150, 190, 230, 280, 380, 450, 600, 750, 900 MHz. The response time of the equipment under test shall be considered and the dwell time shall be sufficient to allow the equipment under test to react under normal conditions. In any case, it shall not be less than two seconds.

6. CHARACTERISTICS OF TEST SIGNAL TO BE GENERATED

6.1 Maximum Envelope Excursion

The maximum envelope excursion of the test signal shall equal the maximum envelope excursion of an unmodulated sine wave whose r.m.s. value is defined in clause 6.2 of this standard.

6.2 Test Signal Wave Form

The test signal shall be a radio frequency sine wave, amplitude modulated by a 1 kHz sine wave at a modulation depth m of 0.8 ± 0.04.

6.3 Modulation Depth

The modulation depth m is defined as:

$$m = \frac{\text{Maximum Envelope Excursion- Minimum Envelope Excursion}}{\text{Maximum Envelope Excursion + Minimum Envelope Excursion}}$$

7. STRIPLINE TESTING

7.1 Test Method

This test method consists of subjecting the wiring harness connecting the components in an ESA to specified field strengths.

7.2 Field Strength Measurement in the Stripline

At each desired test frequency, a level of power shall be fed into the stripline to produce the required field strength in the test area with the ESA under test absent; this level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded. These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated. During this process, the position of the field probe head shall be under the active conductor, centred in longitudinal, vertical and transversal directions. The probe's electronics shall be as far away from the longitudinal stripline axis as possible.

7.3 Installation of the ESA Under Test

7.3.1 150 mm Stripline Testing

The test method allows the generation of homogeneous fields between an active conductor (the stripline 50Ω impedance), and a ground plane (the conducting surface of the mounting table), between which part of the wiring harness may be inserted. The electronic controller(s) of the ESA under test shall be installed on the ground plane but outside the stripline with one of its edges parallel to the active conductor of the stripline. It shall be 200 ± 10 mm from a line on the ground plane directly under the edge of the active conductor. The distance between any edge of the active conductor and any peripheral device used for measurement shall be at least 200 mm. The wiring harness section of the ESA under test shall be placed in a horizontal attitude between the active conductor and the ground plane (See Figures 1 and 2 of Appendix 1 to this Annex).

7.3.1.1 The minimum length of the wiring harness, which shall include the power harness to the electronic control unit and shall be placed under the stripline, shall be 1.5 m unless the wiring harness in the vehicle is less than 1.5 m. In this case, the length of the wiring harness shall be that of the longest length of harness used in the vehicle. Any line branches occurring in this length shall be routed perpendicularly to the longitudinal axis of the line.

7.3.1.2 Alternatively, the fully extended length of the wiring harness, including the length of the longest of any branches, shall be 1,5 m.

7.3.2. 800 mm Stripline Testing

7.3.2.1 Test Method

The stripline consists of two parallel metal plates 800 mm apart. The equipment under test is positioned centrally between the plates and subjected to an electromagnetic field (See Figures 3 and 4 of Appendix 1 to this Annex). This method can be used to test complete electronic systems, including sensors and actuators as well as the controller and wiring loom. It is suitable for apparatus whose largest dimension is less than 1/3 of the distance between the plates.

7.3.2.2 Positioning of Stripline

The stripline shall be housed in a screened room (to prevent external emissions) and positioned 2 m away from walls and any metallic enclosure to prevent electromagnetic reflections. RF absorber material may be used to damp these reflections. The stripline shall be placed on non-conducting supports at least 0.4 m above the floor.

7.3.2.3 Calibration of the Stripline

A field measuring probe shall be positioned within the central 1/3 of the space between the plates with the system under test absent. The associated measuring equipment shall be sited outside the screened room. At each desired test frequency, a level of power shall be fed into the stripline to produce the required field strength at the probe. This level of forward power, or another parameter directly related to the forward power required to define the field, shall be used for type approval tests unless changes occur in the facilities or equipment which necessitate this procedure being repeated.

7.3.2.4 Installation of the ESA Under Test

The main control unit shall be positioned within the central 1/3 of the space between the plates. It shall be supported on a stand made from non-conducting material.

7.3.2.5 Main Wiring Loom and Sensor/Actuator Cables

The main wiring loom and any sensor/actuator cables shall rise vertically from the control unit to the top ground plate (this helps to maximise coupling with the electromagnetic field). Then they shall follow the underside of the plate to one of its free edges where they shall loop over and follow the top of the ground plate as far as the connections to the stripline feed. The cables shall then be routed to the associated equipment which shall be sited in an area outside the influence of the electromagnetic field, e.g. on the floor of the screened room not less than 1 m from the stripline.

8. FREE FIELD ESA IMMUNITY TEST

8.1 Test Method

This test method allows the testing of vehicle electrical/electronic systems by exposing an ESA to electromagnetic radiation generated by an antenna.

8.2 Test Bench Description

The test shall be performed on a bench inside a semi-anechoic chamber the anechoic portion of which extends to the bench top.

8.2.1 Ground Plane

8.2.1.1 For free field immunity testing, the ESA under test and its wiring harnesses shall be supported 50 ± 5 mm above a wooden or equivalent

non-conducting table. However, if any part of the ESA under test is intended to be electrically bonded to a vehicle's metal bodywork, that part shall be placed on a ground plane and shall be electrically bonded to the ground plane. The ground plane shall be a metal sheet with a minimum thickness of 0.5 mm. The minimum size of the ground plane depends on the size of the ESA under test but shall allow for the distribution of the ESA's wiring harness and components. The ground plane shall be connected to the protective conductor of the earthing system. The ground plane shall be situated at a height of 1.0 ± 0.1 m above the test facility floor and shall be parallel to it.

8.2.1.2 The ESA under test shall be arranged and connected according to its requirements. The power supply harness shall be positioned along, and within 100 mm of, the edge of the ground plane/table closest to the antenna.

8.2.1.3 The ESA under test shall be connected to the grounding system according to the manufacturer's installation specification; no additional grounding connections shall be permitted.

8.2.1.4 The minimum distance between the ESA under test and all other conductive structures, such as walls of a shielded area (with the exception of the ground plane/table underneath the test object) must be 1.0 m.

8.2.1.5 The dimension of any ground plane shall be 2.25 m2 or larger in area with the smaller side no less than 750 mm. The ground plane shall be bonded to the chamber with bonding straps such that the DC bonding resistance shall not exceed 2.5 milliohms.

8.2.2 Installation of ESA Under Test

For large equipment mounted on a metal test stand, the test stand shall be considered a part of the ground plane for testing purposes and shall be bonded accordingly. The faces of the test sample shall be located at a minimum of 200 mm from the edge of the ground plane. All leads and cables shall be a minimum of 100 mm from the edge of the ground plane and the distance to the ground plane (from the lowest point of the harness) shall be 50 ± 5 mm above the ground plane. Power shall be applied to the ESA under test via an (5 μ H/ 50 Ω) artificial network (AN).

8.3 Field Generating Device Type, Position and Orientation

8.3.1 Field Generating Device Type

8.3.1.1 The field generating device type(s) shall be chosen such that the desired field strength is achieved at the reference point (See paragraph 8.3.4 of this Annex) at the appropriate frequencies.

8.3.1.2 The field generating device(s) may be one or more antennas or a plate antenna.

8.3.1.3 The construction and orientation of any field generating device shall be such that the generated field is polarised: from 20 to 1,000 MHz horizontally or vertically.

8.3.2 Height and Distance of Measurement

8.3.2.1 Height

The phase centre of any antenna shall be 150 ± 10 mm above the ground plane on which the ESA under test rests. No parts of any antenna's radiating elements shall be closer than 250 mm to the floor of the facility.

8.3.2.2 Distance of Measurement

8.3.2.2.1 In-service conditions may best be approximated by placing the field generating device as far from the ESA as practical. This distance will typically lie within the range 1 to 5 m.

8.3.2.2.2 If the test is carried out in an enclosed facility, the antenna's radiating elements shall be no closer than 0.5 m to any radio absorbent material and no closer than 1.5 m to the wall of the facility. There shall be no absorbent material interposed between the transmitting antenna and the ESA under test.

8.3.3 Antenna Location Relative to ESA Under Test

8.3.3.1 The field generating device's radiating elements shall not be closer than 0.5 m to the edge of the ground plane.

8.3.3.2 The phase centre of the field generating device shall be on a plane which:

(i) is perpendicular to the ground plane;

(ii) bisects the edge of the ground plane and the mid-point of the principal portion of the wiring harness; and

(iii) is perpendicular to the edge of the ground plane and the principal portion of the wiring harness.

The field generating device shall be placed parallel to this plane (See Figures 1 and 2 of Appendix 4 to this Annex).

8.3.3.3 Any field generating device which is placed over the ground plane or ESA under test shall extend over the ESA under test.

8.3.4 Reference Point

For the purpose of this Annex, the reference point is the point at which the field strength shall be established and shall be defined as follows:

8.3.4.1 At least 1 m horizontally from the antenna phase centre or at least 1 m vertically from the radiating elements of a plate antenna;

8.3.4.2 On a plane which:

(i) is perpendicular to the ground plane;

(ii) is perpendicular to the edge of the ground plane along which the principal portion of the wiring harness runs; and

(iii) bisects the edge of the ground plane and the mid-point of the principal portion of the wiring harness;

(iv) coincident with the mid-point of the principal portion of the harness which runs along the edge of the ground plane closest to the antenna.

8.3.4.3 150 ± 10 mm above the ground plane.

8.4 Generation of Required Field Strength: Test Methodology

8.4.1 the "substitution method" shall be used to establish the test field strength necessary.

8.4.2 Substitution Method: Calibration

At each desired test frequency, a level of power shall be fed into the field generating device to produce the required field strength at the reference point (as defined in paragraph 8.3.4) in the test area with the ESA under test absent; this level of forward power, or another parameter directly related to the forward power required to define the field, shall be measured and the results recorded. These results shall be used for type approval tests unless changes occur in the facilities or equipment which necessitates this procedure being repeated.

8.4.3 Extraneous equipment must be a minimum of 1 m from the reference point during calibration.

8.4.4 Field Strength Measuring Device

A suitable compact field strength measuring device shall be used to determine the field strength during the calibration phase of the substitution method.

8.4.5 The phase centre of the field strength measuring device shall be positioned at the reference point.

8.4.6 The ESA under test which may include an additional ground plane shall then be introduced into the test facility and positioned in accordance with the requirements of paragraph 8.3. If a second ground plane is used, then it shall be within 5 mm of the bench ground plane and electrically bounded to it. The required forward power defined in paragraph 8.4.2 at each frequency as defined in paragraph 5 shall then be applied to the field generating device.

8.4.7 Whatever parameter was chosen in paragraph 8.4.2 to define the field, the same parameter shall be used to determine the field strength during the test.

8.5 Field Strength Contour

8.5.1 During the calibration phase of the substitution method (prior to an ESA under test being introduced into the test area), the field strength shall not be less than 50 % of the nominal field strength 0.5 ± 0.05 m either side of the reference point on a line parallel to the edge of the ground plane nearest to the antenna and passing through the reference point.

9. TEM CELL TESTING

9.1 Test Method

The TEM (Transverse Electromagnetic Mode) cell generates homogeneous fields between the internal conductor (septum) and housing (ground plane). It is used for testing ESAs (See Figure 1 of Appendix 3 to this Annex).

9.2 Field Strength Measurement in a TEM Cell

9.2.1 The electric field in the TEM cell shall be determined by using the equation:

$$| E | = \sqrt{\frac{(P \cdot Z)}{d}}$$

E = Electric field (Volts/metre)
P = Power flowing into cell (W)
Z = Impedance of cell (50Ω)
d = Separation distance (metres) between the upper wall and the plate (septum).

9.2.2 Alternatively, an appropriate field strength sensor shall be placed in the upper half of the TEM cell. In this part of the TEM cell the electronic control unit(s) has only a small influence on the test field. The output of this sensor shall determine the field strength.

9.3 Dimensions of TEM Cell

In order to maintain a homogeneous field in the TEM cell and to obtain repeatable measurement results, the test object shall not be larger than 1/3 of the cell inside height. Recommended TEM cell dimensions are given in Appendix 3, Figures 2 and 3 to this Annex.

9.4 Power, Signal and Control Wires

The TEM cell shall be attached to a co-axial socket panel and connected as closely as possible to a plug connector with an adequate number of pins. The supply and signal leads from the plug connector in the cell wall shall be directly connected to the test object. The external components such as sensors, power supply and control elements can be connected:

(i) to a screened peripheral;

(ii) to a vehicle next to the TEM cell; or

(iii) directly to the screened patchboard.

Screened cables must be used in connecting the TEM cell to the peripheral or the vehicle if the vehicle or peripheral is not in the same or adjacent screened room.

10. BULK CURRENT INJECTION TESTING

10.1 Test Method

This is a method of carrying out immunity tests by inducing currents directly into a wiring harness using a current injection probe. The injection probe consists of a coupling clamp through which the cables of the ESA under test are passed. Immunity tests can then be carried out by varying the frequency of the induced signals. The ESA under test may be installed on a ground plane as in paragraph 8.2.1 or in a vehicle in accordance with the vehicle design specification.

10.2 Calibration of Bulk Current Injection Probe Prior to Commencing Tests

The injection probe shall be mounted in a calibration jig. Whilst sweeping the test frequency range, the power required to achieve the current specified in paragraph 6.2 of this standard, shall be monitored. This method is used to calibrate the bulk current injection system forward power versus current prior to testing, and it is this forward power which shall be applied to the injection probe when connected to the ESA under test via the cables used during calibration. It should be noted that the monitored power applied to the injection probe is the forward power.

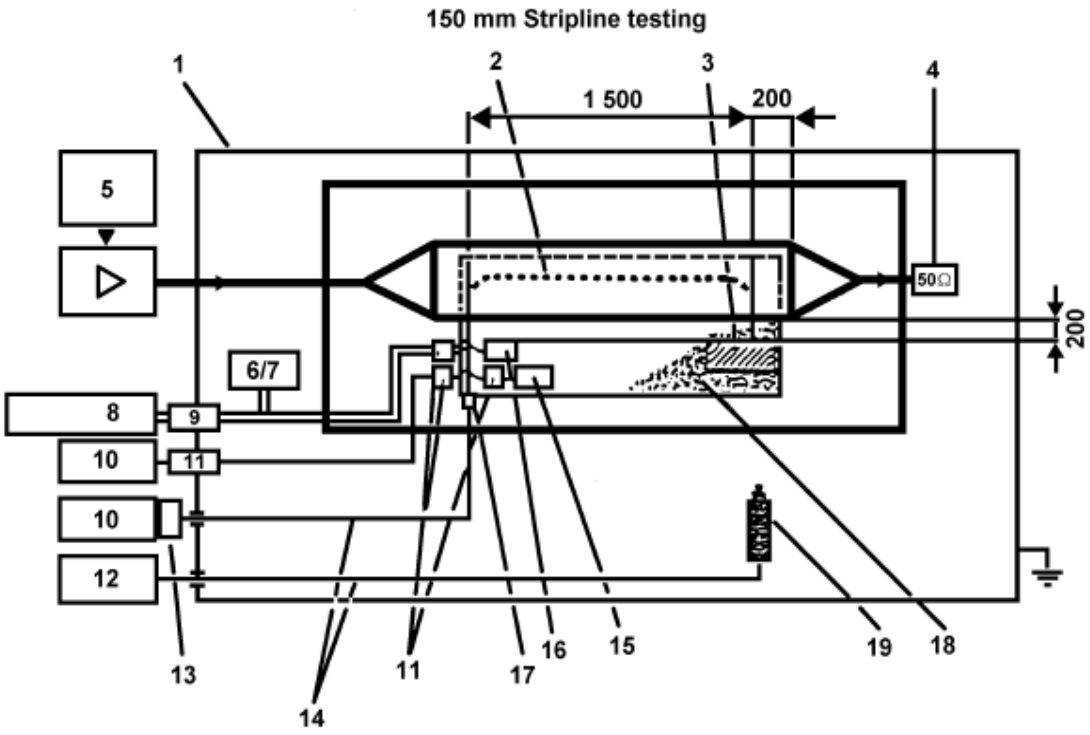
10.3 Installation of the ESA Under Test

For an ESA mounted on a ground plane as in paragraph 8.2.1, all cables in the wiring harness should be terminated as realistically as possible and preferably with real loads and actuators. For both vehicle-mounted and ground plane-mounted ESAs, the current injection probe shall be mounted around all the wires in the wiring harness to each connector and 150 ± 10 mm from each connector of the Electronic Control Unit (ECU), instrument modules or active sensors as illustrated in Figure 1 of Appendix 2.

10.4 Power, Signal and Control Wires

For an ESA under test mounted on a ground plane as in paragraph 8.2.1, a wiring harness shall be connected between an artificial network (AN) and the principal Electronic Control Unit (ECU). This harness shall run parallel to the edge of the ground plane and 200 mm minimum from its edge. This harness shall contain the power feed wire which is used to connect the vehicle battery to this ECU and the power return wire if used on the vehicle. The distance from the ECU to the AN shall be 1.0 ± 0.1 m or shall be the harness length between the ECU and the battery as used on the vehicle, if known, whichever is the shorter. If a vehicle harness is used then any line branches which occur in this length shall be routed along the ground plane but perpendicular away from the edge of the ground plane. Otherwise, the other wires which are in this length shall break out at the AN.

ANNEX 2 - APPENDIX 1

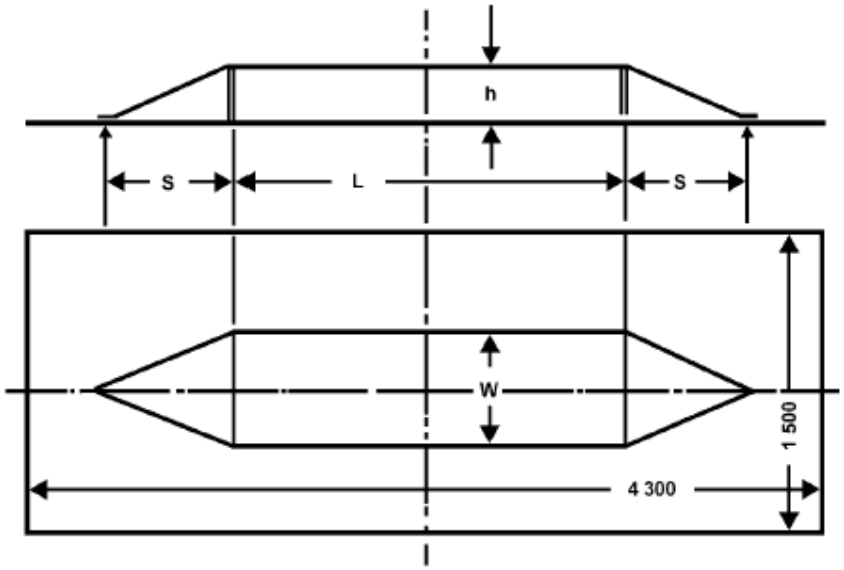


1 = Shielded room
2 = Cable harness
3 = Test object
4 = terminating resistance
5 = Frequency generator
6/7 = Alternative battery
8 = Power supply
9 = Filter
10 = Peripheral
11 = Filter
12 = Video peripheral
13 = Opto-electrical converter
14 = Optical lines
15 = Non irradiation-proof perpheral
16 = Linear or radiation-proof peripheral
17 = Opto-electrical converter
18 = Insulating base
19 = Video camera

All dimensions in millimetres

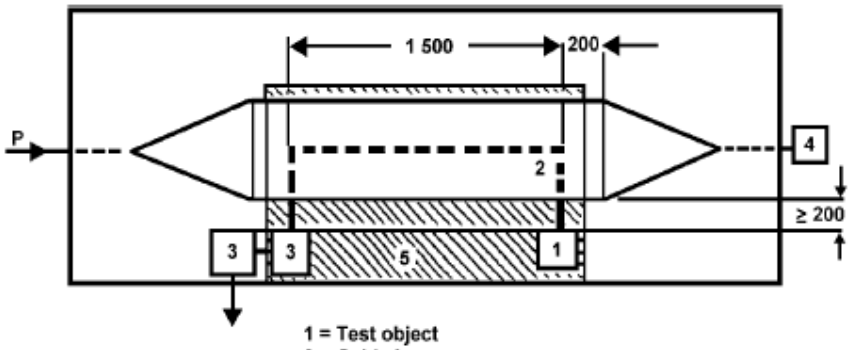
Figure 1

ANNEX 2 - APPENDIX 1 (Cont'd)



L = 2 500 mm
S = 800 mm
W = 740 mm
h = 150 mm

All dimensions in millimetres



1 = Test object
2 = Cable harness
3 = Peripheral
4 = Terminating resistance
5 = Insulting base

Figure 2

ANNEX 2 - APPENDIX 1 (Cont'd)

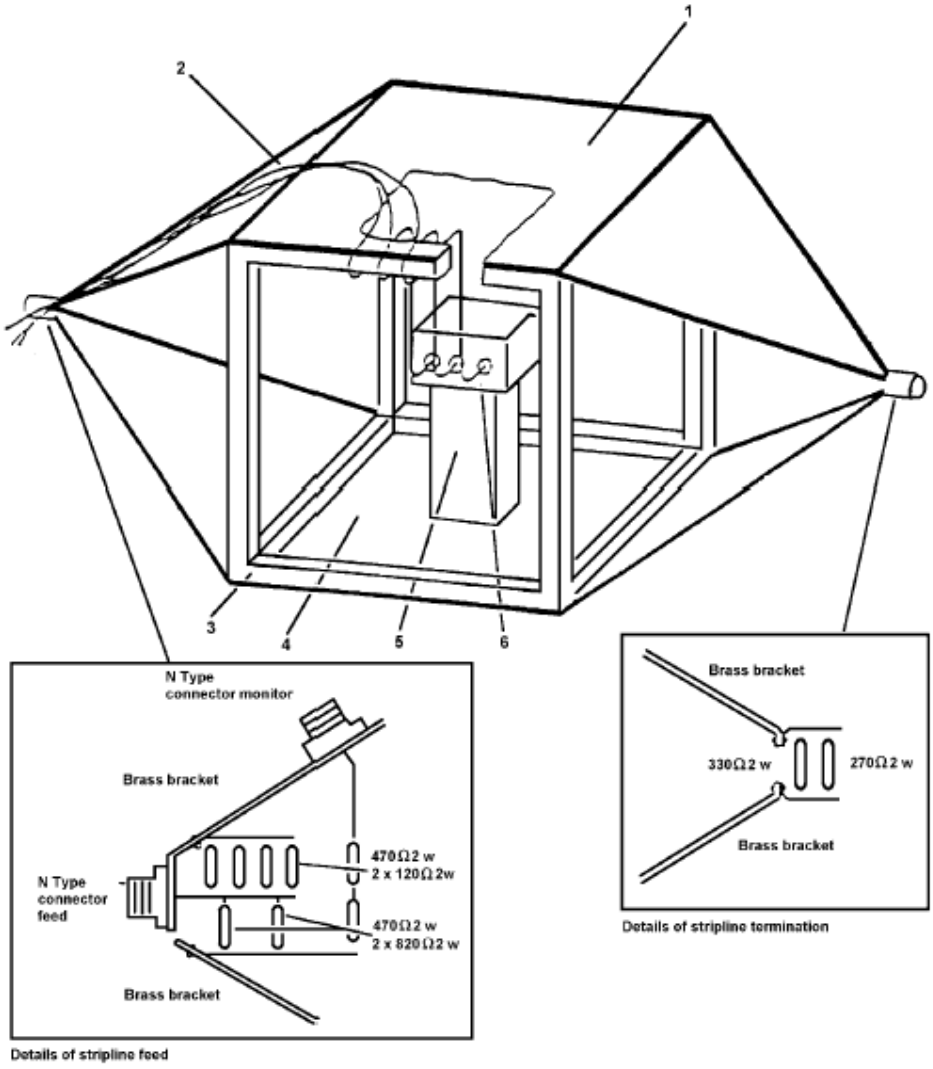
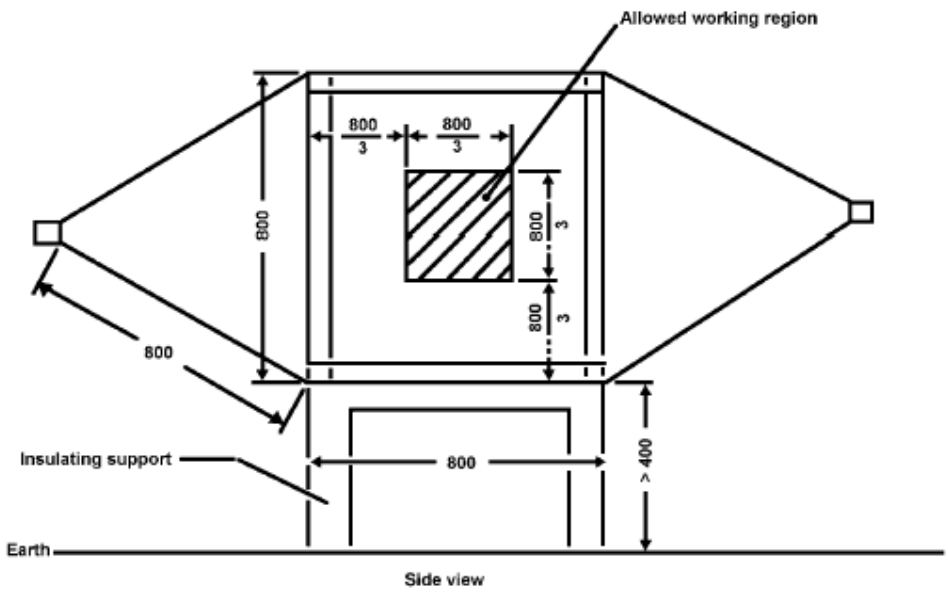
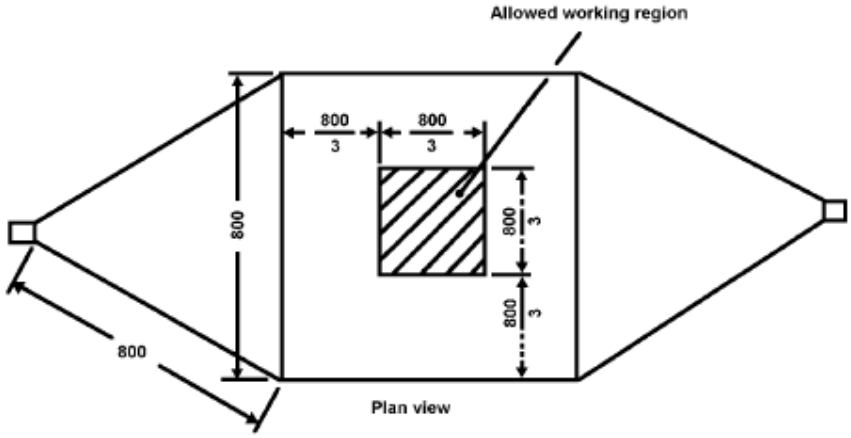


Figure 3

800 mm Strip line Testing

ANNEX 2 - APPENDIX 1 (Cont'd)



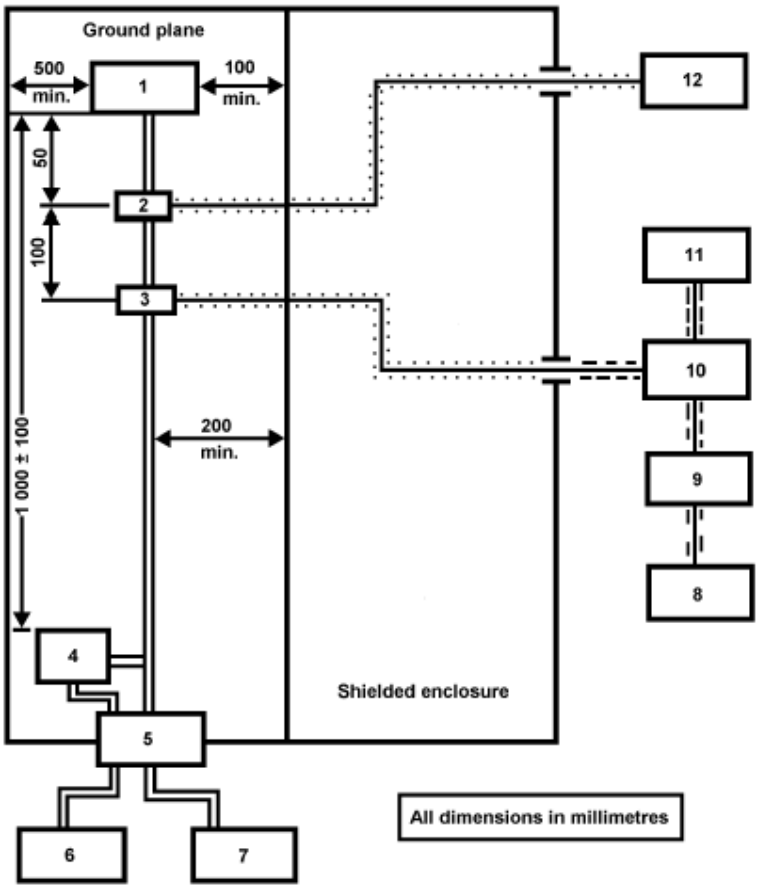


All dimensions in millimetres

Figure 4

800 mm Stripline Dimensions

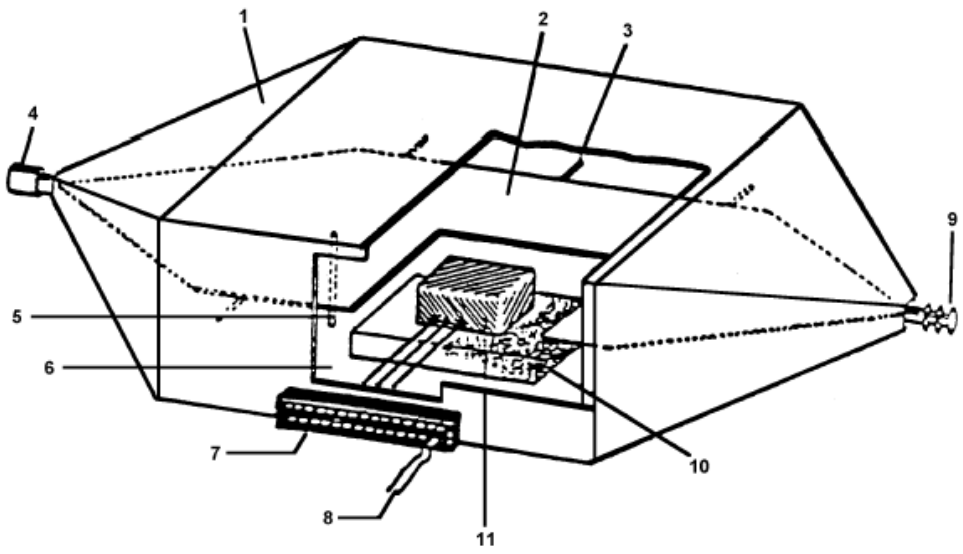
ANNEX 2 - APPENDIX 2



1 = ESA
2 = RF measuring probe (optional)
3 = RF injection probe
4 = Artificial network
5 = Shielded room filter network
6 = Power source
7 = ESA interface: stimulation and monitoring equipment
8 = RF signal generator
9 = Broadband amplifier
10 = RF 50 Ω directional complex
11 = RF or equivalent measuring system
12 = Spectrum analyser or equivalent (optional)

Figure 1
Bulk Current Injection Measurement Installation

ANNEX 2 - APPENDIX 3



1 = Outer conducter, shield
2 = Inner conducter (septum)
3 = Insulator
4 = Input
5 = Insulator
6 = Door
7 = Socket panel
8 = Test object power supply
9 = Terminating resistance 50 Ω
10 = Insulation
11 = Test object (maximum height one third of distance between cell floor and septum)

Figure 1

TEM Cell Testing

ANNEX 2 - APPENDIX 3 (Cont'd)

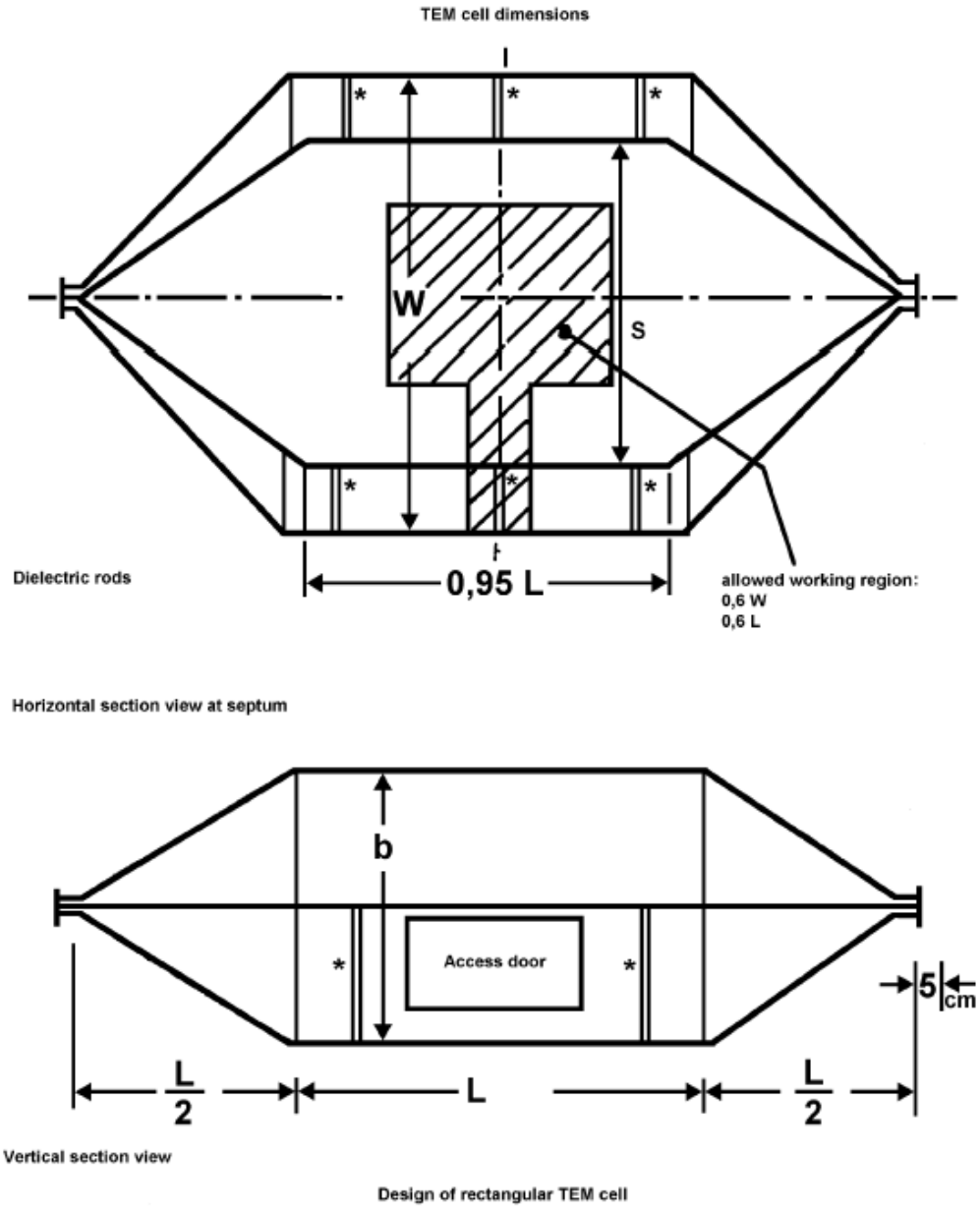


Figure 2

ANNEX 2 - APPENDIX 3 (Cont'd)

The following Table shows the required dimensions of a TEM cell on the basis of upper frequency limits:

Upper frequency (MHz)	Cell form factor W :b	Cell form factor L/W	Plate separation b (cm)	Spectum S (cm)
200	1.69	0.66	56	70
200	1.00	1	60	50

Figure 3

Standard TEM Cell Dimensions

ANNEX 2 - APPENDIX 4

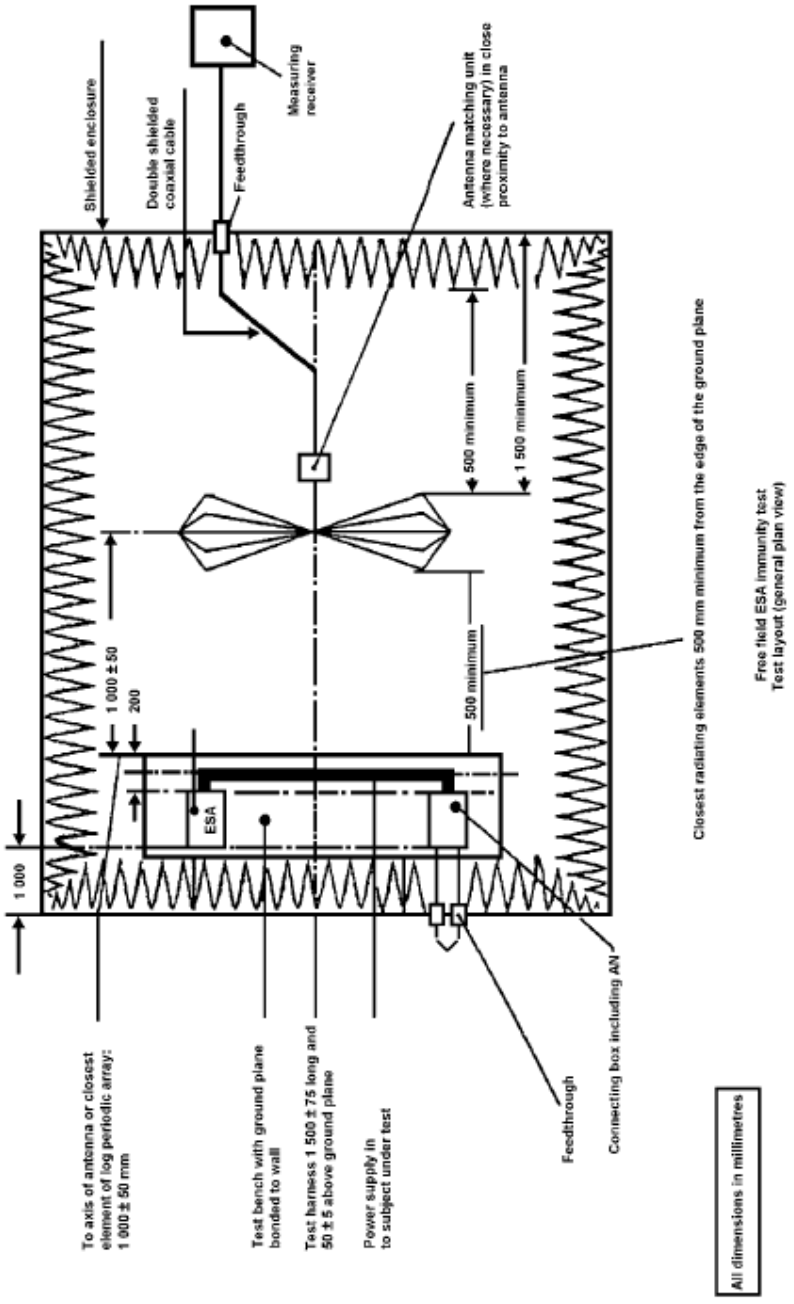


Figure 1

ANNEX 2 - APPENDIX 4 (Cont'd)

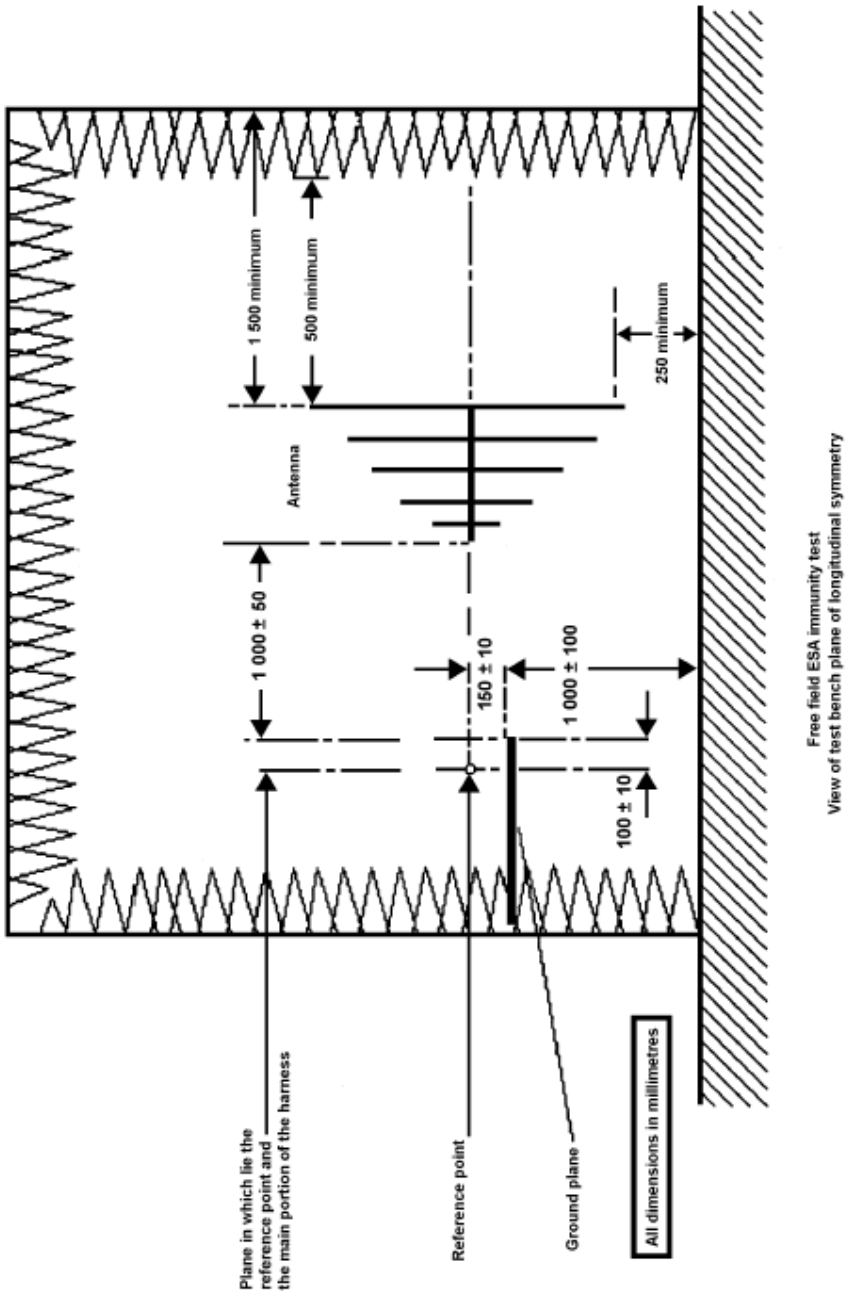


Figure 2

ANNEX 3

(See 5.4)

GUIDELINES FOR DECIDING APPLICABILITY, WORST CASE CRITERIA (WCC) AND CRITERIA FOR EXTENSION OF APPROVAL (CEA) FOR RADIATED IMMUNITY TEST

Applicability:

1. Vehicle fitted with any of the Electronic Sub-Assembly (ESA) as per list given below shall be subjected to immunity test:

Sr. No.	ESA	Immunity Test Needed	Remarks
1.	Electronic Engine Control Unit (ECU) for • Fuel injection • Ignition timing control • Combined fuel injection and ignition timing control • Engine valve control • EGR • Idle speed control • Exhaust emission / after-treatment control • Air-fuel ratio control • Electronic carburettor	Yes	Only in conjunction with vehicle
2.	ECUs for Drive by Wire System (Electronic Accelerator Pedal and/or Electronic Brake)	Yes	Only in conjunction with vehicle
3.	Cruise Control System	Yes	Only in conjunction with vehicle
4.	ECU for Anti-skid Braking System (ABS)	Yes	Only in conjunction with vehicle
5.	Electronic 4-wheel Drive	Yes	Only in conjunction with vehicle
6.	ECU for Electronic Gear Shift Control System (Automatic Transmission or CVT)	Yes	Only in conjunction with vehicle
7.	Electronic Steering Control (Electronic Power Steering)	Yes	Only in conjunction with vehicle
8.	Motor Control Unit in case of BOVs	Yes	Only in conjunction with vehicle
9.	Electronic Speed Limiter	Yes	In conjunction with vehicle or as an ESA
10.	Air Bag and Safety Restraint System	Yes	In conjunction with vehicle or as an ESA
11.	Electronic Seat Adjustment Control System	Yes	In conjunction with vehicle or as an ESA

Sr. No.	ESA	Immunity Test Needed	Remarks
12.	Electronic Rear View, Side View Mirror Adjustment Control System	Yes	In conjunction with vehicle or as an ESA
13.	Electronic Lamp Control Device	Yes	In conjunction with vehicle or as an ESA
14.	Electronic Headlamp Leveling / Adjustment System	Yes	In conjunction with vehicle or as an ESA
15.	Gas-discharge Headlamp with Electronic Ballast	Yes	In conjunction with vehicle or as an ESA
16.	Electronic Rotating Identification Lamp and/or Siren Combination	Yes	In conjunction with vehicle or as an ESA
17.	Stop Lamp, Rear Position Lamp, End Outline Marker Lamp using Electronic Components such as LED etc.	Yes	In conjunction with vehicle or as an ESA
18.	Electronic Flasher with Direction Indicators	Yes	In conjunction with vehicle or as an ESA
19.	Electronic Horn	Yes	In conjunction with vehicle or as an ESA
20.	Electronic Anti-theft Device for Unauthorised Use including RF Immobiliser and Vehicle Alarm System	Yes	In conjunction with vehicle or as an ESA
21.	Automatic Door Lock System including Infrared Door Lock System	Yes	In conjunction with vehicle or as an ESA
22.	Electronic Suspension Control	Yes	In conjunction with vehicle or as an ESA
23.	Electronic Instrument Cluster including on-board indicators related to functions in subparagraphs (a) or (b) of Cl. 5.1	Yes	In conjunction with vehicle or as an ESA
24.	Navigation System	Yes	In conjunction with vehicle or as an ESA
25.	Wiper Control System	Yes	In conjunction with vehicle or as an ESA
26.	Tire Pressure Monitoring System	Yes	In conjunction with vehicle or as an ESA
27.	Digital Tachograph	Yes	In conjunction with vehicle or as an ESA
28.	Telematic System	Yes	In conjunction with vehicle or as an ESA

The above list is not exhaustive and it is for guidance only. Due to continuous technological advancements, it is not practicable to list all the ESAs that will require immunity test. In such case, guidelines for immunity related vehicle functions as per Cl. 5.0 shall be considered.

2. Any change in parameters mentioned below will require separate immunity test as per below:

Sr. No.	Parameter	Immunity Test Needed	Remarks
1.	Change in engine location	Yes	Change in position and general mounting arrangement of engine consequent to situations like front engine to rear engine etc.
2.	Change in body style and or material affecting overall shielding of vehicle electronics	Yes	e.g. roof top body, drive away chassis, passenger vehicle to goods vehicle, metallic body to non-metallic body and vice versa etc.
3.	Change in make, identification mark/part number of ESA as a result of change in design of hardware or vendor of ESA or addition of new ESA altogether.	Yes	These changes affect immunity performance of ESA and hence that of the vehicle.

Changes other than those listed above are considered to be having no adverse effect on Immunity requirements of vehicle.

Worst Case Criteria (WCC)

Normally base vehicle model shall be subjected to immunity test. Where vehicle model is with one or more variants then the variant with fully loaded version (variant fitted with maximum electronic systems including optional ones) and one with fully open body (e.g. drive away chassis as the case may be) shall be subjected to the immunity test. Bi-fuel vehicle model (e.g. petrol/CNG, petrol/LPG) with petrol mode as limp-home mode shall be tested only in gaseous mode for immunity if it involves ESAs as above. Bi-fuel vehicle model with no limp-home mode shall be tested separately in each fuel mode for immunity if it involves ESAs as above. However, if petrol mode of such vehicle model is tested and type approved for immunity requirements as per this standard earlier, then it shall not be retested in petrol mode again.

Criteria for Extension of Approval (CEA)

In the whole vehicle testing, ESAs that are fitted to the vehicle gain approval as a separate technical unit specific to that vehicle type. For any change in ESA or addition of new ESA, immunity test can be performed either on ESA as a component or as fitted to the vehicle. ESAs that are involved in direct control of vehicle (viz. ESA list sr. no. 1 to 8) shall be tested for immunity in conjunction with the vehicle only. As regards other ESAs, they can be tested and approved for immunity requirements as a component and extension of type approval can be granted to vehicle based on component approval when such ESAs are incorporated in the vehicle. ESAs approved as component can be fitted in any vehicle type.

ANNEX 4A
(See 7.0)

TECHNICAL SPECIFICATIONS FOR TYPE APPROVAL OF A VEHICLE WITH RESPECT TO RADIATED IMMUNITY REQUIREMENTS

The following information shall be supplied in triplicate and shall include a list of contents.

Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 or in a folder of A4 format.

Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

GENERAL

1. Make (trade name of manufacturer):
……...……

2. Model Name and Variants:
……

3. Category of vehicle:
……...……..….

4. Name and address of manufacturer:
……...……..

Name and address of authorised representative, if any:
……...

5. Address(es) of assembly plant(s):
……...…….….

GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE

6. Photograph(s) and/or drawing(s) of a representative vehicle:
…….…….

7. Position and arrangement of the engine:
…….……..

POWER PLANT

8. Manufacturer:
……...…….

9. Manufacturer's engine code as marked on the engine:
……..……

10. Internal combustion engine:

11. Working principle: positive ignition/compression ignition, four-stroke/two stroke

12. Number and arrangement of cylinders:
……...…….

13. Fuel feed:

14. By fuel injection (compression ignition only): yes/no

15. By fuel injection (positive ignition only): yes/no

16. Electronic control unit:

17. Make(s):
……...……

18. Description of the system:
……...……..…

19. Electrical system:

20. Rated voltage: ……. V, positive/negative ground

21. Generator:

22. Type:
……...…….

23. Ignition:

24. Make(s):
……...……

25. Type(s):
……...……..

26. Working principle:
……...…….

27. LPG fuelling system: yes/no

28. Electronic engine management control unit for LPG fuelling:

29. Make(s):
……...……

30. Type(s):
……...…….

31. NG fuelling system: yes/no

32. Electronic engine management control unit for NG fuelling:

33. Make(s):
……...……

34. Type(s):
……...…….

35. Electric motor:

36. Type (winding, excitation):
……...……

37. Operating voltage:
……...…….…

Gas fuelled engines (in the case of systems laid-out in a different manner, supply equivalent information)

38. Electronic control unit (ECU):

39. Make(s):
……...……

40. Type(s):
……...…….

TRANSMISSION

41. Type (mechanical, hydraulic, electric, etc.):
…….

42. A brief description of the electrical/electronic components (if any):
……...

SUSPENSION

43. A brief description of the electrical/electronic components (if any):
……...

STEERING

44. A brief description of the electrical/electronic components (if any):
……...

BRAKES

45. Anti-lock braking system: yes/no/optional

46. For vehicles with anti-lock systems, description of system operation (including any electronic parts), electric block diagram, hydraulic or pneumatic circuit plan:
…….……

BODYWORK

47. Type of bodywork:
……..……

48. Materials used and methods of construction:
……...

49. Windscreen and other windows:

50. A brief description of the electrical/electronic components (if any) of the window lifting mechanism:
…….…….

51. Rear-view mirrors (state for each mirror):
……

52. A brief description of the electronic components (if any) of the adjustment system:
……...

53. Safety belts and/or other restraint systems:

54. A brief description of the electrical/electronic components (if any):
……...

55. Suppression of radio interference:

56. Description and drawings/photographs of the shapes and constituent materials of the part of the body forming the engine compartment and the part of the passenger compartment nearest to it:
……..

57. Drawings or photographs of the position of the metal components housed in the engine compartment (e.g. heating appliances, spare wheel, air filter, steering mechanism, etc.):
……...

58. Table and drawing of radio interference control equipment:
……...

59. Particulars of the nominal value of the direct current resistance and, in the case of resistive ignition cables, of their nominal resistance per metre:
……...

LIGHTING AND LIGHT-SIGNALLING DEVICES

60. A brief description of electrical/electronic components other than lamps (if any):
……
……

MISCELLANEOUS

61. Devices to prevent unauthorised use of the vehicle:

62. A brief description of the electrical/electronic components (if any):
……..

The application for type approval shall also include, where appropriate:

1. A list (with make(s) and type(s) of all electrical and/or electronic components concerned by this Standard (see Annex 3 of this Standard) and not previously listed.

2. Schematics or drawing of the general arrangement of electrical and/or electronic components (concerned by this Standard) and the general wiring harness arrangement.

3. Description of vehicle chosen to represent the type:

   Body style:
   ……..……..

   Wheelbase:
   …….

ANNEX 4B
(See 7.0)

TECHNICAL SPECIFICATIONS FOR TYPE APPROVAL OF AN ELECTRIC / ELECTRONIC SUB-ASSEMBLY WITH RESPECT TO RADIATED IMMUNITY REQUIREMENTS

The following information, if applicable, shall be supplied in triplicate and must include a list of contents. Any drawings shall be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

1. Make (trade name of manufacturer):
……

2. Model Name:
…….

3. Means of identification of type, if marked on the component/separate technical unit:

3.1. Location of that marking:
…….

4. Name and address of manufacturer:
…….

Name and address of authorized representative, if any:
……..

……

5. Address(es) of assembly plant(s):
…….

6. This ESA shall be approved as a component/STU

7. Any restrictions of use and conditions for fitting:
……

8. Electrical system rated voltage: …… V, positive/negative/ground.

9. Description of the ESA (electronic block diagram and list of main component constituting the ESA (e.g. make and type of microprocessor, crystal, etc.)).

ANNEX 5

(See Introduction)

COMMITTEE COMPOSITION *

Automotive Industry Standards Committee

Chairman	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
Members	**Representing**
Representative from	Ministry of Shipping, Road Transport & Highways (Dept. of Road Transport & Highways), New Delhi
Shri Sushil Kumar	Ministry of Heavy Industries & Public Enterprises (Department of Heavy Industry), New Delhi
Shri J. K. Arya	Office of the Development Commissioner, Small Scale Industries, Ministry of Small Scale Industries, New Delhi
Shri S. M. Bhatia Shri Rakesh Kumar (Alternate)	Bureau of Indian Standards, New Delhi
Prof. A. V. Sardesai Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Dr. M. O. Garg	Indian Institute of Petroleum, Dehra Dun
Dr. C. L. Dhamejani	Vehicles Research & Development Establishment, Ahmednagar
Representatives from	Society of Indian Automobile Manufacturers
Shri T.C. Gopalan Shri Ramakant Garg (Alternate)	Tractor Manufacturers Association, New Delhi
Shri K.N.D. Nambudiripad	Automotive Components Manufacturers Association, New Delhi
Shri Arvind Gupta	Automotive Components Manufacturers Association, New Delhi

Member Secretary
Mrs. Rashmi Urdhwareshe
Deputy Director
The Automotive Research Association of India, Pune

* At the time of approval of this Automotive Industry Standard (AIS)