The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE STANDARD

SAE J551/1

Issued 1994-03-04

Submitted for recognition as an American National Standard

PERFORMANCE LEVELS AND METHODS OF MEASUREMENT OF ELECTROMAGNETIC COMPATIBILITY OF VEHICLES AND DEVICES (60 Hz TO 18 GHz)

Foreword—This document brings together methodology for testing the electromagnetic emissions and immunity characteristics of vehicles[1] and devices[2]. The writers of this document have participated extensively in the drafting of CISPR Subcommittee D and ISO TC 22 Subcommittee 3 documents.

By intent, the methods and limits of this document closely resemble the counterpart international standards.

SAE J551/1—General and Definitions
SAE J551/2—Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats and Spark-ignited Engine-driven Devices, Broadband, 30 to 1000 MHz
SAE J551/3—Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles and Devices, Narrowband, 10 kHz to 1000 MHz
SAE J551/4—Test Limits and Methods of Measurement of Radio Disturbance Characteristics: Measurement of Emissions Received by an Antenna on the Same Vehicle, Broadband and Narrowband, 150 kHz to 1000 MHz
SAE J551/5—Performance Levels and Methods of Measurement of Electric Vehicles, Broadband and Narrowband, 9 kHz to 1000 MHz
[Parts 6 through 10 reserved for future use]
SAE J551/11—Vehicle Electromagnetic Immunity—Off-vehicle Source
SAE J551/12—Vehicle Electromagnetic Immunity—On-board Transmitter Simulation
SAE J551/13—Vehicle Electromagnetic Immunity—Bulk Current Injection (BCI)
SAE J551/14—(Reserved)—Vehicle Electromagnetic Immunity—Reverberation Chamber
SAE J551/15—Vehicle Electromagnetic Immunity—Electrostatic Discharge (ESD)
SAE J551/16—(Reserved)—Vehicle Electromagnetic Immunity—Conducted Transients
SAE J551/17—(Reserved)—Vehicle Electromagnetic Immunity—Magnetic Fields

Reference to SAE J551 without a suffix (/___) shall be interpreted to mean SAE J551/1 and J551/2.

---

[1] See 3.52 for definition
[2] See 3.18 for definition

Printed in U.S.A.
90-1202B EG

1. ***Scope***—This SAE Standard covers the measurement of radio frequency radiated emissions and immunity. Each part details the requirements for a specific type of electromagnetic compatibility (EMC) test and the applicable frequency range of the test method.

The methods are applicable to a vehicle or other device powered by an internal combustion engine or electric motor. Operation of all engines (main and auxiliary) of a vehicle or device is included. All equipment normally operating when the engine is running is included. Operator-controlled equipment is included or excluded as specified in the individual document parts.

The recommended levels apply only to complete vehicles in their final manufactured form. Vehicle-mounted rectifiers used for charging in electric vehicles are included in Part 2 of this document when operated in their charging mode.

Emissions from intentional radiators are not controlled by this document. (See applicable appropriate regulatory documents.) The immunity of commercial mains powered equipment to overvoltages and line transients is not covered by this document. (See applicable UL or other appropriate agency documents.)

2. *References*

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J551/2—Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles, Motorboats and Spark-ignited Engine-driven Devices, Broadband, 30 to 1000 MHz

SAE J551/3—Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles and Devices, Narrowband, 10 kHz to 1000 MHz

SAE J1812—Function Performance Status Classification for EMC Susceptibility

2.1.2 ANSI PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI C63.2-1987— American National Standard for Instrumentation—Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz—Specifications

ANSI C63.4-1992— American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.14-1992—Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD)

ANSI C95.1-1992— American National Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

ANSI/IEEE STD 100-1988—Standard Dictionary of Electrical and Electronic Terms

2.1.3 CISPR PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

CISPR 12 3rd Edition:1990-01—Limits and methods of measurement of radio interference characteristics of vehicles, motor boats, and spark-ignited engine-driven devices

CISPR 16:1993—CISPR specification for radio interference measuring apparatus and measurement methods

CISPR 22:1985—Limits and methods of measurement of radio interference characteristics of information technology equipment

DIS CISPR 25—Test Limits and Methods of Measurement of Radio Disturbance Characteristics: Part A—Measurement of Emissions Received by an Antenna on the Same Vehicle; Part B—Measurement of Vehicle Components and Modules for Protection of On-board Radio Receivers

2.1.4 IEC PUBLICATION—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

IEC Publication 50(161):1990—International Electrotechnical Vocabulary—Electromagnetic Compatibility

IEC Publication 50(726):1982—International Electrotechnical Vocabulary—Transmission Lines and Waveguides

2.1.5 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO TR 10305:1992—Generation of standard em fields for calibration of power density meters—20 kHz to 1000 MHz

ISO TR 10605:1992—Road vehicles—electrical disturbances from electrostatic discharges

ISO DIS 11451:1993—Road vehicles—Electrical disturbances by narrowband radiated electromagnetic energy —Vehicle test methods (under development)

*3. **Definitions***—All definitions used in any part of this document are included in this part. For the purpose of this document, the definitions contained in IEC Publications 50(161) and 50(726) are applicable. For additional definitions refer to ANSI/IEEE STD 100.

The following definitions are specific to this series of documents:

3.1 Absorber-Lined Chamber—A shielded room with absorbing material on its internal reflective surfaces (floor absorber material optional). (Adapted from ISO DIS 11451-1.)

3.2 Amplitude Modulation (AM)—The process by which the amplitude of a carrier wave is varied following a specified law. The result of the process is an AM signal. (ISO DIS 11451-1)

3.3 Antenna Correction Factor—The factor which is applied to the voltage measured at the input connector of the measuring instrument to give the field strength at the antenna. (Adapted from CISPR/D (Secretariat) 102, Apr 1993.)

3.4 **Antenna Matching Unit**—A unit for matching the impedance of an antenna to that of the 50 Ω measuring instrument over the antenna measuring frequency range. (CISPR/D (Secretariat) 102, Apr 1993)

3.5 **Artificial Network (AN) [Line Impedance Stabilization Network (LISN)]**—A network inserted in the supply leads of apparatus to be tested which provides, in a given frequency range, a specified load impedance for the measurement of disturbance voltages and which isolates the apparatus from the power supply in that frequency range. (Adapted from IEC 50:1990-161-04-05.)

3.6 **Bandwidth**—The width of the frequency band over which a given characteristic of an equipment does not differ from its reference value by more than a specified amount of ratio. (IEC 50:1990-161-06-09)

3.7 **Broadband Artificial Network (BAN)**—A network that presents a controlled impedance to the device under test over a specified frequency range while allowing the device under test to be interfaced to its support system. It is used in power, signal, and control lines.

3.8 **Broadband Emission**—An emission which has a bandwidth greater than that of a particular measuring apparatus or receiver. (IEC 50:1990-161-06-13)

3.9 **Bulk Current**—Total amount of common mode current in a harness. (ISO DIS 11451-1)

3.10 **Bulk Current Injection Probe**—A device for injecting current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits.

3.11 **Characteristic Level**—The controlling (or dominant) emission level experienced in each frequency sub-band. The characteristic level is the maximum measurement obtained for both antenna polarizations and for all the specified measurement positions of the vehicle or device. Known ambient signals shall not be considered part of the characteristic level. (CISPR 12 draft 4th Edition)

3.12 **Class**—An arbitrary performance level agreed upon by the purchaser and the supplier and documented in the test plan. (CISPR/D (Secretariat) 102, Apr 1993)

3.13 **Component Conducted Emissions**—The noise voltages/currents of a nature existing on the supply or other wires of a component/module. (Adapted from CISPR/D (Secretariat) 102, Apr 1993.)

3.14 **Compression Point**—The input signal level at which the gain of the measuring system becomes nonlinear such that the indicated output deviates from an ideal receiving system's output by the specified increment in dB. (CISPR/D (Secretariat) 102, Apr 1993)

3.15 **Coupling**—A means or a device for transferring power between systems. (IEC 50:1982-762-14-01)

3.16 **Current (Measurir.g) Probe**—A device for measuring the current in a conductor without interrupting the conductor and without introducing significant impedance into the associated circuits. (IEC 50:1990-161-04-35)

3.17 **Degradation (of performance)**—An undesired departure in the operational performance of any device, equipment, or system from its intended performance. (IEC 50:1990-161-01-19)

3.18 Device—A machine equipped with an internal combustion engine but not self-propelled. Devices include, but are not limited to, chain saws, irrigation pumps, and air compressors. [This definition applies only to SAE J551/2 and /3.] (Adapted from draft CISPR 12, 4th edition.)

3.19 Directional Coupler—A three- or four-port device consisting of two transmission lines coupled together in such a manner that a single traveling wave in any one transmission line will induce a single traveling wave in the other; the direction of propagation of the latter wave being dependent upon that of the former. (IEC 50:1982-726-14-02)

3.20 Disturbance Suppression—Action which reduces or eliminates electrical disturbance. (IEC 50:1990-161-03-22)

3.21 Disturbance Voltage; Interference Voltage—Voltage produced between two points on separate conductors by an electromagnetic disturbance, measured under specified conditions. (IEC 50:1990-161-04-01)

3.22 Electromagnetic Compatibility (EMC)—The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment. (IEC 50:1990-161-01-07)

3.23 Electromagnetic Disturbance—Any electromagnetic phenomenon which may degrade the performance of a device, equipment, or system or adversely affect living or inert matter. (IEC 50:1990-161-01-05)

3.24 (Electromagnetic) Immunity (to a disturbance)—The ability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance. (IEC 50:1990-161-01-20)

3.25 Electromagnetic Interference (EMI)—Degradation of the performance of equipment, transmission channel, or system caused by an electromagnetic disturbance. (IEC 50:1990-161-01-06)

3.26 (Electromagnetic) Radiation

a. The phenomena by which energy in the form of electromagnetic waves emanates from a source into space.
b. Energy transferred through space in the form of electromagnetic waves. (IEC 50:1990-161-01-10)

3.27 (Electromagnetic) Susceptibility—The inability of a device, equipment, or system to perform without degradation in the presence of an electromagnetic disturbance. (IEC 50:1990-161-01-21)

3.28 Forward Power—That power supplied by the output of an amplifier (or generator) traveling towards the load. (Adapted from ISO DIS 11451-1.)

3.29 Ground (reference) Plane—A flat conductive surface whose potential is used as a common reference. (IEC 50:1990-161-04-36)

3.30 Ignition Noise Suppressor—That part of a high-voltage ignition circuit intended to limit the emission of impulsive ignition noise. (CISPR 12 3rd Ed 1990-01)

3.31 Immunity Level—The maximum level of a given electromagnetic disturbance incident on a particular device, equipment, or system for which it remains capable of operating at a required degree of performance. (IEC 50:1990-161-03-14)

3.32 **Impulse Electric Field Strength**—The root-mean-square value of the sinusoidally varying radiated electric field producing the same peak response in a bandpass system, antenna, and bandpass filter, produced by the unknown impulse electric field.

3.33 **Impulse Noise**—Noise characterized by transient disturbances separated in time by quiescent intervals.

NOTE—The typical frequency spectrum of these disturbances will be substantially uniform over the pass band of the transmission system.

(Adapted from ANSI/IEEE Std 100.)

3.34 **Impulsive Ignition Noise**—The unwanted emission of electromagnetic energy, predominantly impulsive in content, arising from the ignition system within a vehicle or device. (CISPR 12 3rd Ed 1990-01)

3.35 **Interference Suppression**—Action which reduces or eliminates electrical interference. (IEC 50:1990-161-03-23)

3.36 **Measuring Instrument Impulse Bandwidth**—The maximum value of the output response envelope divided by the spectrum amplitude of an applied impulse.

3.37 **Modulation Factor (m)**—The ratio of the peak variation of the envelope from its reference value to the reference value. The reference value is usually taken to be the amplitude of the unmodulated wave. The value of m varies between 0 and 1.

3.38 **Narrowband Emission**—An emission which has a bandwidth less than that of a particular measuring apparatus or receiver. (IEC 50:1990-161-06-13)

3.39 **Net Power**—Forward power minus reflected power at the same location on the transmission line. (Adapted from ISO DIS 11451-1.)

3.40 **Peak Detector**—A detector, the output voltage of which is the peak value of the applied signal. (IEC 59:1990-161-04-24)

3.41 **Polarization (of a wave or field vector)**—The property of a sinusoidal electromagnetic wave or field vector defined at a fixed point in space by the direction of the electric field strength vector or of any field vector; when the direction varies with time, the property may be characterized by the locus described by the extremity of the considered field vector. (IEC 50:1982-726-04-01)

3.42 **Quasi-peak Detector**—A detector having specified electrical time constants which, when regularly repeated identical pulses are applied to it, delivers an output voltage which is a fraction of the peak value of the pulses, the fraction increasing towards unity as the pulse repetition rate is increased. (IEC 50:1990-161-04-21)

3.43 **Receiver Terminal Voltage**—The external voltage measured in dB (μV) at the input of a radio interference measuring instrument conforming to the requirements of CISPR Publication 16 or ANSI C63.2. (Adapted from CISPR/D (Secretariat) 102, Apr 1993.)

3.44 **Reflected Power**—That power traveling toward the amplifier (or generator) reflected by the load caused by impedance mismatch between the transmission line and the load. (Adapted from ISO DIS 11451-1.)

3.45 Resistive Distributor Brush—The resistive pick-up brush in an ignition distributor cap. (CISPR 12 3rd Ed 1990-01)

3.46 RF Ambient (electromagnetic environment)—The totality of electromagnetic phenomena existing at a given location. (IEC 50:1990-161-01-01)

3.47 Shall—Used to express a command; i.e., conformance with the specific recommendation is mandatory and deviation is not permitted. The use of shall is not qualified by the fact that compliance with the standard is considered voluntary.

3.48 Shielded Enclosure—A mesh or sheet metallic housing designed expressly for the purpose of separating electromagnetically the internal and external environment. (ISO 50:1990-161-04-37)

3.49 Standing Wave Ratio (SWR); Voltage Standing Wave Ratio (VSWR)—The ratio, along a transmission line, of a maximum to an adjacent minimum magnitude of a particular field component of a standing wave. (IEC 50:1982-726-07-09)

3.50 Tracking Generator—A narrowband radio frequency source synchronized to the instantaneous receive frequency of the measuring instrument. (Draft CISPR 12, 4th Edition)

3.51 Transmission Line System (TLS)—A TLS is a stripline or parallel plate or similar device to generate an E-field. (Adapted from ISO DIS 11451-1.)

3.52 Vehicle; Ground-vehicle—A self-propelled machine (excluding aircraft and rail vehicles and boats over 10 m in length). Vehicles may be propelled by an internal combustion engine, electrical means, or both. Vehicles include but are not limited to automobiles, trucks, agricultural tractors, mopeds, snowmobiles, and small motorboats.

4. Overview of Test Methods

4.1 The attributes of the radiated emissions tests are shown in Table 1.

TABLE 1—RADIATED EMISSIONS TEST ATTRIBUTES

SAE J551 Part	Test Type	Frequency Range	Test Distance	Comparable Standard
2	Broadband	30 MHz to 1000 MHz	10 m	CISPR 12
3	Narrowband	10 kHz to 1000 MHz	10 m	CISPR TBD
4	Narrow and Broad	150 kHz to 1000 MHz	NA	CISPR 25
5	Narrow and Broad	10 kHz to 1000 MHz	10 m	CISPR TBD

NOTE—Future systems may require new tests.

4.2 The attributes of the immunity tests are shown in Table 2.

TABLE 2—IMMUNITY TEST ATTRIBUTES

SAE J551 Part	Test Type	Frequency Range	Comparable Standard
11	Off-vehicle source	10 kHz to 18 GHz	ISO 11451/2
12	On-vehicle source	1.8 MHz to 1.2 GHz	ISO 11451/3
13	Bulk current injection	1 MHz to 400 MHz	ISO 11451/4
14	Reverb chamber (future)	200 MHz to 18 GHz	
15	Electrostatic discharge	N/A	ISO 10605
16	Transient immunity	N/A	
17	Magnetic field	60 Hz to 30 kHz	

NOTE—Future systems may require new tests.

5. Standard Emissions Test Conditions

a. Ambient level—6 dB below test level
b. Temperature—not controlled
c. Humidity—noncondensing
d. Separation from absorber material—1 m minimum
e. Clear area—see individual test requirements
f. Vehicle operating voltage—within designed operating range
g. Engine temperature—within designed operating range
h. Vehicle equipment—operating at worst case noise producing condition

6. Standard Immunity Test Procedures—The common characteristics for all of the immunity test parts of this document are described in this section.

6.1 Test Conditions

a. Test temperature and supply voltage
b. Modulation
c. Dwell time
d. Frequency steps

6.1.1 TEST TEMPERATURE AND SUPPLY VOLTAGE—Heat is generated in the test facility when the vehicle is operated during performance of the test. Sufficient cooling must be provided to ensure that the engine does not overheat. The ambient temperature in the test facility shall be recorded if it is outside the range of 23 °C ± 5 °C.

For tests that require the vehicle engine to be running, the electrical charging system shall be functional. For tests where the vehicle engine is not required to be running, the battery voltage shall be maintained above 12.2 V and 24.4 V for 12 V and 24 V systems, respectively.

6.1.2 MODULATION—The characteristics of the systems of the vehicle determine the type and frequency of modulation. If no values are agreed upon between the users of this document, the following shall be used:

a. No modulation (CW)
b. 1 kHz sinewave amplitude modulation (AM) 80%. (See Appendix B, Constant Peak Test Method.)

6.1.3 DWELL TIME—At each frequency, the vehicle shall be exposed to the test level for the minimum response time needed to control the subsystems of the vehicle. In all cases, this minimum time of exposure shall be 2 s, min.

6.1.4 FREQUENCY STEPS—All of the RF immunity tests in this document, except part 12 (On-board Transmitter Simulation), shall be conducted with the maximum frequency step sizes given in Table 3 (according to the applicable frequency range of each part).

TABLE 3—FREQUENCY STEPS

Frequency Band	Maximum Frequency Step Size
10 kHz to 100 kHz	10 kHz
100 kHz to 1 MHz	100 kHz
1 MHz to 10 MHz	1 MHz
10 MHz to 200 MHz	2 MHz
200 MHz to 1 GHz	20 MHz
1 GHz to 18 GHz	200 MHz

Alternatively, logarithmic steps, with the same minimum number of frequency steps in each frequency band, can be used. The values as agreed upon by the users of this document shall be documented in the test report.

NOTE— If it appears that the susceptibility thresholds of the vehicle are very close to the chosen test level, these frequency steps should be reduced in the concerned frequency range in order to find the minimum susceptibility thresholds.

6.2 Test Methods—Some parts of this document present two test methodologies:

a. The Substitution Method

The substitution method is based upon the use of NET POWER as the reference parameter used for calibration and test.

In this method the specific test level (E-field, current, voltage, or power) shall be calibrated prior to actual testing.

The test with the vehicle is then conducted by subjecting the vehicle to the test plan signals based on the calibrated values as predetermined in the test plan.

Measurements using the substitution method can be affected by coupling between the antenna and the vehicle as well as by reflected energy. During the test, the net power shall be maintained relative to the calibration point up to a limit of 2 dB increase in forward power.

NOTE 1— If the forward power has to be increased by 2 dB or more, this shall be indicated in the test report.

NOTE 2— If the SWR in the test system can be demonstrated to be less than 1.2, then forward power may be used as the reference parameter to establish the test level.

b. The Closed-Loop Leveling Method

During the actual test, the test level (E-field, voltage, current, or power) is measured by a calibrated device and fed back to the signal generator to either increase or decrease the test level until the predetermined value is achieved.

6.2.1 CALIBRATION—Calibration shall be performed in accordance with individual test method's requirements. The test level versus frequency data shall be established using a CW signal. The method and results for each calibration shall also be documented.

6.2.2 TESTS WITH A VEHICLE

CAUTION— Hazardous radio frequency voltages and fields may exist within the test area. Care should be taken to ensure that the requirements for limiting the exposure of humans to RF energy are met. ANSI C95.1 is the US National Standard addressing exposure of humans to electromagnetic fields.

The test procedure shall apply the following specifications:

a. At each frequency, increase the level, linearly or logarithmically, up to the chosen test level.

The rate of increase of the test level shall be controlled so that excessive overshoot does not occur.

The test level parameter is (see Appendix A regarding test level specification):

(1) The NET POWER, related to the test signal severity level, for the substitution method. See Equation 1.

$$\text{NET POWER (Test signal)} = \text{NET POWER (Calibration)} \left(\frac{\text{Test signal severity level}}{\text{Calibration level}} \right)^{k} \qquad \text{(Eq.1)}$$

with k=1 for power test levels and k=2 for field, current, or voltage test levels.

(2) The TEST SIGNAL SEVERITY LEVEL for the closed-loop leveling method.

Table 4 gives the CW and AM test levels for the substitution method and for the closed-loop leveling method.

TABLE 4—CW AND AM TEST LEVELS

	CW	AM
Substitution Method	Net Power	$\frac{2+m^2}{2(1+m)^2} \times$ Net power
Closed-Loop Leveling Method	Test Signal Severity Level	Test Signal Severity Level

where m is the modulation factor

Both of these methods use a constant peak test level for CW and AM tests. The relationship between AM net power and CW calibrated net power results from this principle (see Appendix B).

b. Maintain the test level for the minimum response time needed to exercise the vehicle (this minimum time of exposure shall be greater or equal to 2 s).

c. Decrease the test level by at least 20 dB before moving to the next frequency.

The rate of decrease of the level shall be controlled to avoid unreproducible susceptibilities.

NOTE—Turning off the signal generator may cause unrepeatable susceptibilities of the vehicle.

d. Step to the next frequency.

6.3 Test Severity Levels—For both substitution and closed-loop leveling methods and for CW and AM tests, the test severity levels of this document are expressed in terms of equivalent RMS (root-mean-square level) value of an unmodulated wave.

EXAMPLE—Test severity level of 20 V/m means that CW and AM test will be conducted for a 28 V/m peak value.

PREPARED BY THE SAE EMI STANDARDS COMMITTEE

APPENDIX A
FUNCTION PERFORMANCE STATUS CLASSIFICATION
(BASED ON SAE J1812)
(INFORMATIVE)

A.1 Scope and Field of Application—The purpose of this appendix is to provide a general method for defining function performance status classification for the functions of automotive electronic devices upon application of the test conditions specified as described in this series of documents.

A.2 General—It must be emphasized that components or systems shall only be tested with the conditions, as described in the main part of the document, that represent the simulated automotive electromagnetic environments to which the devices would actually be subjected. This will help to assure a technically and economically optimized design for potentially susceptible components and systems.

It should also be noted that this appendix is not intended to be a product specification and cannot function as one. Nevertheless, using the concepts described in this appendix and by careful application and agreement between manufacturer and supplier, this document could be used to describe the functional status requirements for a specific device. This could then, in fact, be a statement of how a particular device could be expected to perform under the influence of the specified interference signals.

A.3 Essential Elements of Function Performance Status Classification—There are four elements required to describe a function performance status classification:

A.3.1 Test Method and Test Signal—This element refers to the respective test signal(s) applied to the device under test and the method of test. This information is contained in the appropriate section of each part of this document.

A.3.2 Functional Status Classifications—This element classifies the operational status of the function for an electrical/electronic device within the vehicle:

a. Class A—Any function that provides a convenience (e.g., entertainment, comfort).
b. Class B—Any function that enhances, but is not essential to the operation or control of the vehicle (e.g., speed display).
c. Class C—Any function that is essential to the operation or control of the vehicle (e.g., braking, engine management).

A.3.3 Region of Performance—This element describes the region, bounded by two test signal levels, that defines the expected performance objectives of the device under test.

a. Region I—The function shall operate as designed during and after exposure to a disturbance.
b. Region II—The function may deviate from design during exposure but will return to normal after the disturbance is removed.
c. Region III—The function may deviate from designed performance during exposure to a disturbance but simple operator action may be required to return the function to normal, once the disturbance is removed.
d. Region IV—The device/function must not sustain any damage after the disturbance is removed.

A.3.4 Test Signal Level—This element defines the specification of test signal level and essential parameters. The test signal severity level is the stress level (voltage, volts per meter, etc.) applied to the device under test.

A.4 Application of Function Performance Status Classification—Figure A1 illustrates the relationship of Function Status Classifications, Region of Performance, and Test Pulse Severity Level of a given test method.

FUNCTIONAL STATUS CLASSIFICATIONS

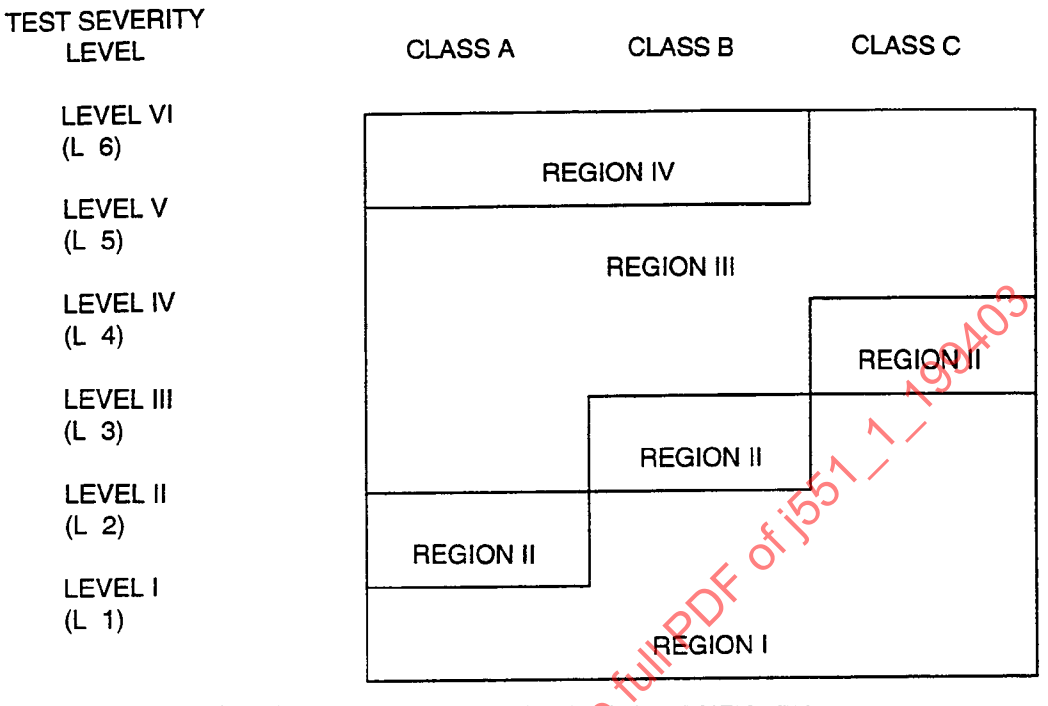

FIGURE A1—FUNCTIONAL STATUS CLASSIFICATIONS

A.5 Example of Test Pulse Severity Selection Table—The following two examples illustrate the selection table of test pulse severity levels for Conducted Immunity Testing and Radiated Immunity Testing as described in the main part of the document (table only partially completed to demonstrate concept):

CONDUCTED IMMUNITY TESTING

PULSE SEVERITY	PULSE 1	PULSE 2	PULSE 3a	PULSE 3b	PULSE 4	PULSE 5
			(VOLTS)			
L 6	V					
L 5	0.8 V					
L 4	0.6 V					
L 3	0.4 V					
L 2	0.2 V					
L 1						

FIGURE A2—EXAMPLE OF TEST PULSE SEVERITY SELECTION TABLE

RADIATED IMMUNITY TESTING

Test Severity Levels	E Field Strength (volts/meter)
L 6	E
L 5	0.8 E
L 4	0.6 E
L 3	0.4 E
L 2	0.2 E
L 1	

FIGURE A3—EXAMPLE OF TEST SIGNAL SEVERITY LEVEL SELECTION TABLE