The latest EU directive on Electro-Magnetic Compatibility

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Introduction

EMC legislation for vehicles has changed from only being required to allow interference free TV and radio reception, to requirements that ensure the modern vehicle functions safely in the presence of radio transmitters. The correct application of 95/54/EC has made significant improvements in road safety but the difficulties of correctly applying to aftermarket parts, especially radio parts, have been recognized. The new directive attempts to remove the anomalies and to provide requirements appropriate for modern vehicles and their suppliers. The latest directive is reviewed and the relationship with other current EMC legislation, including 89/336/EEC is discussed.

Directives and Automotive EMC

The generic EMC Directive, 89/336/EEC, was published in 1989, came into full effect on 1 January 1996 and applied to all electrical and electronic equipment. Article 2.2 of 89/336/EEC provides an exemption for apparatus covered by a product specific directive.

Since 1972 the European automotive industry has had a relevant directive, 72/245/EEC, which covered the suppression of radio interference from spark ignition engines. To comply with 89/336/EEC the automotive industry initiated an amendment to 72/245/EEC to cover the EMC of motor vehicles. The automotive EMC directive 95/54/EC amended 72/245/EEC to provide harmonized EMC protection requirements for most vehicles of 4 wheels or more and all devices intended to be fitted to them. It ensures that vehicles operate safely in their electromagnetic environment and do not emit excessive levels of electromagnetic radiation. Aftermarket equipment is included so that the essential requirements for vehicle type approval are not compromised. It is recognized that all EMC phenomena necessary for the in-vehicle EMC environment are not covered by 95/54/EC. Confusion has been caused by 95/54/EC stating that it is the sole EMC requirement for vehicle and devices intended for use in vehicles.

The European Commission Guidance on 89/336/EEC and 95/54/EC was amended in May 2003 to specify that for EMC phenomena not covered by the automotive specific directive the requirements of 89/336/EEC for “CE” marking applied. The proposed new generic EMC directive (replacing 89/336/EEC) states that “*This Directive shall not apply to equipment or requirements in so far as the requirements laid down in this Directive are harmonised by more specific Community legislation.*” This would appear to match the guidance published for 89/336/EEC. 95/54/EC was written with the assumption that any devices fitted to a

vehicle, including aftermarket parts, would be subject to the vehicle manufacturer's requirements for all EMC phenomena. In practice the vehicle manufacturer does not have this level of control on aftermarket parts. This confusion over approval is a problem that the European Commission guidance was published to address. Certainly it is recognized that aftermarket parts, which are only tested to the limited requirements of 95/54/EC, may have reliability problems for the end user.

95/54/EC was worded such that it could be interpreted that radio-transmitting equipment could only be installed if approved by the vehicle manufacturer. Understandably the European radio industry could not accept this interpretation by some countries. They viewed it as a barrier to trade. There were meetings over a number of years between the industries as they attempted to come to an understanding for the application of 95/54/EC. At one time it was believed that an understanding had been reached on the key issue of how radio equipment could gain approval under 95/54/EC as aftermarket ESAs. The UK's Vehicle Approval Authority's interpretation had been published by the discussion group and had received favorable comment from the Commission. However by this time the European Commission had decided to fund an investigation into the problem. Eventually this was published as the York report. This lead the European Commission to insist on a re-write of 95/54/EC to include some of the key points from the York report. The industries worked together to draft a new directive and presented it to the Commission in 2002. Directive 2004/XX/EC was approved in the Committee for Adaptation to Technical Progress (CATP) in May this year. Publication in the Official Journal of the European Community is awaited. This agreement of the European governments took over a year to achieve after the vehicle industry and the radio industry agreed on the basic wording. A number of details have been amended or inserted to meet the views of the governments. The new directive has responded to the radio industry's complaint that some countries and some vehicle manufacturers were using 95/54/EC approvals as a barrier to trade, but it also gives the vehicle manufacturer the facility to place limits on radio use in their vehicles.

This new directive recognizes the requirement for any aftermarket part to be "CE" marked and calls for this together with requirements on the tests required for some EMC phenomena as well as continuing to require automotive type approval for any device that may affect road safety.

This new directive has to be in national law by 31 December 2005 with type approval to it possible from 1 January 2006. New type vehicles and Electronic Sub-Assemblies are required to comply from 1 July 2006. However, existing types of vehicles and ESAs do not need to comply until 1 January 2009.

The new automotive EMC directive

At first sight this new directive seems similar to 95/54/EC. However when read carefully it shows a large number of changes both small and large, both administrative and technical. This paper discusses the ones that are of most importance.

Immunity related functions

Immunity related functions are defined in annex I paragraph 2.1.12. They are grouped as:

- ?? functions relating to direct control,
- ?? functions related to driver, passenger and other road user protection,
- ?? functions which when disturbed cause confusion to the driver or other road user,

- ?? functions related to vehicle data bus functionality,
- ?? and functions which when disturbed affect vehicle statuary data.

The details given for each of these is given as “example” it is expected that the Technical Service will be obliged to make a technical assessment and give a ruling on what is an immunity related function if it is not listed as one of the examples.

“CE” and/or “e”

95/54/EC stated: “the technical requirements relating to the radio interference (electromagnetic compatibility) of vehicles, their components and systems should be governed from 1 January 1996 solely by the provisions of directive 72/245/EEC (as amended by 95/54/EC). 2004/XX/EC does not have this statement. This change matches the Commission’s guidance on the relationship of 95/54/EC to 89/336/EEC:

> “For ***new types*** of vehicles placed on the EEA market after 1/01/1996, ***new types*** of components and ***new types*** of separate technical units intended to be fitted into motor vehicles and placed on the EEA market after 1/01/1996, the specific Directive 95/54/EC ***is mandatory.*** These products must bear the 'e' marking that confers free movement throughout the EEA area. For the phenomena it doesn't cover, Directive 89/336/EEC continues to apply, reason for which such products should also continue to carry the CE mark.”

It can be argued that this does not mean that vehicles should be “CE” marked as they are exempted from this by the Machinery directive. However it is certainly reasonable to require this for aftermarket products and 2004/XX/EC recognizes this and allows for “non-immunity related” parts to be “CE” marked only, but subject to a Technical Service assessment to ensure road safety is not compromised. The document required from the Technical Service is defined in Annex IIIC. Interestingly it also requires a “stamp of administration”. Clarification is needed to resolve whether this is to be the authorisation mark of the Technical Service with the document being viewed as the “opinion” of the Technical Service, or the authorisation mark of the Approval Authority. Certainly if the example of Notified Bodies is taken from CE marking directives it is reasonable for the Technical Service to authorize the document defined in Annex IIIC. This procedure is subject to review for necessity within 3 years from the directive entering into force. If it is discontinued it will be left to the competence of the aftermarket supplier to decide whether an ESA is immunity related. Only “CE” marking has the advantage for the supplier in that the vehicle type approval requirement for a formal “Conformity of Production” certification is no longer required.

Test House accreditation

The requirement for test work to be carried out by a test laboratory accredited to ISO 17025 and approved by the approval authority is now stated repeatedly in the directive. Each test annex specifies accreditation to the “applicable parts” of ISO 17025, but an opinion from UKAS (the UK accreditation service) is that all parts are applicable for an accreditation to be awarded. It is also pointed out that both the annexes IIA and IIB specify test report(s) from a test laboratory accredited to ISO 17025 and approved by the approval authority. It is reasonable to assume that the word “applicable” in the testing annexes should be taken to mean an ISO 17025 accreditation to the applicable test standard.

Test methods

In general the confusion in 95/54/EC over the use of spot frequency testing has been removed. The new directive only requires spot frequency testing if the Technical Service did not carry out the full frequency sweep tests. The Technical Service may use spot frequency testing to validate the test evidence supplied by the manufacturer for inclusion in the type approval. In reality a test house accredited to ISO 17025 and approved by the approval

authority and appointed as a Technical Service (if it is Europe) would give a manufacturer the lowest costs for approval if he uses such a Technical Service. It is recognized that some manufacturers may not wish to have the Technical Service directly involved in the full testing in which case the use of spot frequency testing will be required as specified in each of the test annexes (except for annex X).

The radiated immunity test methods of annex VI and IX and the severity test levels defined in annex I require explanation. The test severity level is defined as 30 v/m rms in annex I paragraph 6.4.2.1. Paragraph 1.2 of annex VI specifies the test methods of ISO 11451-2:2002. Clause 3 of this standard specifies the use of terms and definitions given in ISO 11451-1. The modulation should be applied in accordance with ISO 11451-1 paragraph 5.7 (Definition of test severity levels). This approach uses a constant peak power test level for tests with un-modulated and amplitude modulated signals. Similarly ISO 11452 is used in annex IX. It would be easy for a test house to miss-interpret the modulation requirements and use the radio industry's modulation method instead. The difference is an 80% increase in peak field strength.

Annex VI also allows the use of an outdoor test site for radiated immunity testing if national legislation permits. With the power levels used for this sort of testing, the probable level of harmonic emissions and antenna side lobe emissions, it is possible that interference could be caused to radio communication systems, especially the very low power ones used for location by radio technology, such as GPS. As GPS is a fundamental part of the European radio navigation plan it is hoped that the national authorities will recognize the need to ban any form of outdoor testing.

Approval procedures

The present procedure under 95/54/EC is well known and requires the applicant to:

- ?? approach a Technical Service,
- ?? write an annex II (A or B depending whether vehicle or ESA)
- ?? agree the Worst Case,
- ?? test under the control of the Technical Service,
- ?? Agree Conformity of Production (CoP) with the Approval Authority

Subject to a satisfactory package of documentation, CoP and test results, type approval will be granted by the Approval Authority and issued through the Technical Service.
95/54/EC annex I paragraph 3.1.4 is worded to limit the number of vehicles chosen for testing to be 2 of a type. In reality this is not practicable with the wide range of engines and systems fitted to modern vehicles. Similarly paragraph 3.2.4 limits the number of variants of an ESA tested to 2 as well. The interpretation of paragraph 4.3.2.3 for radio products has been different with different approval authorities and has been commented on earlier in this paper. Paragraph 6.2 limited the testing for broadband emissions to vehicles with spark ignition engines with other broadband sources ignored. The Approval Authority is able to "approve" any EMC test laboratory for carrying out the testing without the need for the test to be ISO 17025 accredited.

For a vehicle manufacturer the procedure required by the new directive is very similar to that existing under 95/54/EC. The new directive has changed annex I paragraph 3.1.4 to allow one or more vehicles to be chosen to represent the type as necessary. The broadband test requirement for a vehicle now includes all engine types with all other broadband sources included.
However, under the new directive the aftermarket ESA supplier is obliged to CE mark his product under either 89/336/EEC or 1999/5/EC. His Declaration of Conformity has to be based on compliance with the test requirements of this new directive as well as those demanded by the horizontal directives. The new procedure requires the Technical Service to

review the product and decide if it is immunity related. If it is it must be type approved, if not then the manufacturer has the choice of type approval or asking the Technical Service for an annex IIIC document stating that the product is not immunity related. This approach does not require the manufacturer of a non-immunity related device to meet the CoP requirements of the Approval Authority.

Effects of the new directive

The new directive will have effects on the various organisations as indicated below.

Vehicle Manufacturers

The test requirements for the vehicle manufacturers are now defined more clearly, especially for RF immunity testing. The actual test work carried out by a vehicle manufacturer will not change except that more of his test work currently carried out for product liability reasons will need to be documented and submitted as part of the type approval documentation. This change obliges the vehicle manufacturer to ensure that the test house used is ISO 17025 accredited and also accepted as competent by the approval authority. This may cause difficulties for a few vehicle manufacturers where their in-house test laboratories are not accredited to ISO 17025, but in general it will have the effect of ensuring that all test work is carried out to the highest standard of quality. The requirement for approval authority approval as well should not be considered significant as generally approval authorities would consider that an ISO 17025 accreditation was adequate to give confidence in the test work. The requirement for radio installation information is a significant increase in information required for type approval. For every RF band that a vehicle manufacturer decides is “normally used” in his vehicle, test work and possibly RF field modeling work will be required as part of the submission to the approval authority. It is possible that many vehicle manufacturers will only consider the mobile phone installation requirements as being needed for normal use. The exception will be those vehicles intended for special purposes such as taxi work or emergency service use.

Tier 1 suppliers

Tier 1 suppliers to the vehicle industry are already accustomed to complying with a vehicle manufacturer’s test requirements. These are generally significantly more severe than those of this new directive. The additional mandatory test requirement for transients are only of significance to these suppliers in that they will need to provide additional test evidence to the approval authority. In many cases they will only seek type approval if the vehicle manufacturer requires it or if more than one vehicle manufacturer intends to use the ESA.

Aftermarket suppliers

Aftermarket suppliers who have previously taken advantage of the interpretation of 95/54/EC that said it was the only EMC requirement for an aftermarket product are now required to test for all EMC phenomena. All have to meet the requirements for CE marking, including transient testing. Some which previously were not required to be tested for radiated immunity will now require testing as the “immunity related” functions list has expanded to cover more aspects than those defined in 95/54/EC.
The aftermarket ESA supplier now has a more complex approval procedure. He is obliged to CE mark his product under either 89/336/EEC or 1999/5/EC. His Declaration of Conformity has to be based on compliance with the test requirements of this new directive as well as those demanded by the horizontal directives. The new procedure requires the Technical Service to review the product and decide if it is immunity related. If so it must be type approved, if not then the manufacturer has the choice of type approval or asking the

Technical Service for an annex IIIC document stating that the product is not immunity related. This approach does not require the manufacturer to meet the CoP requirements of the Approval Authority.

Radio transmitter suppliers

Radio transmitter manufacturers will presumably have their products identified as immunity related ESAs by the Technical Service as the RF transmissions could affect direct control. The exception to this is that if the use is limited to vehicles where the vehicle manufacturer has given installation instructions the radio can be classed as non-immunity related, issued with an annex IIIC certificate and only CE marked. However, where a vehicle manufacturer has not done this then the radio manufacturer must provide installation instructions and evidence to the Technical Service that the immunity of the vehicle will not be affected in order for the transmitter to be type approved. Hence “CE” marking alone would limit the use to only the vehicles types where the vehicle manufacturer had listed this type of transmitter and provided installation instructions. The DoC for the “CE” mark would have to be clear on this point

Summary

There are a number of major effects of this new directive:

- ?? Aftermarket suppliers will be required to “CE” mark their products and this will include the relevant EMC tests in this new directive.
- ?? Aftermarket parts that are immunity related will be required to be “e” marked as well.
- ?? Vehicle manufacturers will be required to identify the radio transmitter systems normally used in their vehicles and to provide installation information necessary to ensure the vehicle performance is not affected.
- ?? Aftermarket radio transmitter manufacturers may need to “e” mark their products to cover fitment in all vehicles.
- ?? All test work necessary for a type approval application must be from a test house accredited to ISO 17025 for the applicable testing to international standards.

References

[1] Commission Directive 95/54/EC of 31 October 1995 adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.

[2] Directive EMC 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility.

[3] Commission Directive 2004/XX/EC of xx month 2004 adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.

[4] ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories.

[5] ISO 7637-2 "Road vehicles - Electrical disturbance from conduction and coupling - Part 2: Electrical transient conduction along supply lines only on vehicles with nominal 12 V or 24 V supply voltage", 3rd Draft International Standard 2003

[6] ISO/CD 11451-3: 2003 Road vehicles — Electrical disturbances by narrowband radiated
electromagnetic energy - Vehicle test methods — Part 3: On board
transmitter simulation

[7] CISPR 12 “Vehicles, motorboats and spark-ignited engine driven devices Radio disturbance characteristics - Limits and methods of measurement”, 5th Edition 2001

[8] CISPR 16-1 ”Specifications for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus”, 2nd Edition 2002

[9] ISO 11451 “Road vehicles – Electrical disturbances by narrowband radiated electromagnetic energy – Vehicle test methods”
Part 2: Off vehicle radiation source (CD ISO 11451-2:2002)

[10] ISO 11451 “Road vehicles – Electrical disturbances by narrowband radiated electromagnetic energy – Vehicle test methods”
Part 1: General and definitions (CD ISO 11451-1:2002)

[11] ISO 11451 “Road vehicles – Electrical disturbances by narrowband radiated electromagnetic energy – Vehicle test methods”
Part 4: Bulk current injection (BCI) (ISO 11451-4: 1st Edition 1995)

[12] CISPR 25 “Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles”, 2nd Edition 2002.

[13] ISO 11452 “Road vehicles – Electrical disturbances by narrowband radiated electromagnetic energy – Component test methods”
Part 1: General and definitions (CD ISO 11452-1:2002)

[14] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.