Legislation Update – Radio and EMC in the Automotive Environment

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Radio approval for spectrum management, and vehicle EMC type approval for road safety, are different approvals for different purposes. Modern vehicle applications of radio systems for telematics purposes have resulted in both of these approvals having to be applied to radio systems fitted to vehicles. This paper looks at automotive EMC legislation and its interpretations relating to radio issues. The changes to radio type approval with the implementation of directive 1999/5/EC and the interpretations for automotive systems are discussed.

KEY WORDS

1. Vehicles. 2. Radio. 3. Regulations.

1. INTRODUCTION. The modern vehicle has evolved from one with zero electronic content and negligible electrical content into one with complex electronic systems that affect the direct control of the vehicle. At the same time, the use of radio has increased dramatically with the development of radio systems for vehicle use. These range from mobile phones to vehicle location and navigation systems. For many years, the concern was that the vehicle's spark ignition engine would interfere with radio communications, usually noticed by the public as radio and TV interference. Installation of radio equipment in special purpose vehicles (such as emergency services) was difficult and required expert help to achieve a working radio system. The vehicle itself was completely immune to radio interference as it had no electronic content. The main concern of the radio industry was how to install radio systems in vehicles so that they worked reliably.

With the introduction of electronic systems in vehicles to provide a variety of features essential for legislative requirements for environment protection, together with customer performance features, the modern vehicle has become susceptible to radio frequency interference. At the same time, the use of in-vehicle radio systems has increased as the technology has developed to create products that some vehicle users wish to have in their vehicles.

2. AUTOMOTIVE EMC APPROVAL. The automotive EMC directive is one of many automotive directives. All automotive directives are type approval directives. These require the approval to be carried out under the control of a national approval authority via an appointed Technical Service. This approval is then valid across Europe and is often accepted in many other countries as well.

https://doi.org/10.1017/S0373463300001181 Published online by Cambridge University Press

In 1972, directive 72/245/EEC was the first vehicle EMC directive with the intention of ensuring the vehicle did not pollute the RF spectrum. Directive 95/54/EC amended 72/245/EEC to create a directive specific to vehicles in accordance with the exemption clause in the general EMC directive 89/336/EEC.

Vehicles now have significant electronic content, and radio transmissions may affect the vehicle electronics and hence the direct control of the vehicle. Directive 95/54/EC considers the vehicle in its normal use mode of travelling along a road. Hence it is considered that the vehicle can only cause radiated RF interference, or be susceptible to external radiated interference. The directive also covers the individual electronic systems that are, or may be, fitted to the vehicle, including products only available for fitment after the vehicle is sold. There is a presumption that any electronic product fitted to the vehicle will be suitable for the vehicle's EMC environment and hence only radiated emissions and immunity tests are specified.

Radio systems with intentional transmitters are a special case where it is necessary for the Approval Authority to interpret the directive. An important point from the UK's Approval Authority's interpretation of 95/54/EC is that, when correctly installed and transmitting, the radio system has to be shown not to affect the normal operation of the vehicle.

Table 1. 95/54/EC has been used as the basis for most wheeled vehicle, EMC requirements.

Vehicle type	Directive/ECE R. or standard	Approval mark
Automotive	95/54/EC	'e'
	ECE R10.02	'E'
2/3 wheels	97/24/EC	'e'
	ECE R10.02	'E'
Tractors*	89/336/EEC (until 1 October 2001)	'CE'
	EN ISO 14982	
	2000/2/EC (from 1 January 2001)	'e'
Earthmovers	89/336/EEC	'CE'
	ISO 13766	
Construction	89/336/EEC	'CE'
Equipment	EN 13309	

* Subject to change when 75/322/EEC comes into force. The approval mark will then be an 'e'.

For the special case of electronic equipment that is vehicle anti-theft equipment, directive 95/56/EC and ECE Regulation 97 apply with EMC requirements appropriate for the anti-theft system in the vehicle's EMC environment.

3. EMC APPROVAL UNDER VEHICLE LEGISLATION. This Type Approval procedure is essentially the same for a vehicle or for an electrical/electronic system (sub-assembly). This procedure is followed for 72/245/EEC (as amended by 95/54/EC), 97/24/EC chapter 8, and ECE Regulation 10.02. It will also be followed for 75/322/EEC (as amended by 2000/2/EC) from 1 January 2001.

To obtain type approval in the UK under these directives, application is made to a Technical Service appointed by the Vehicle Certification Agency (VCA) using the following procedure:

a. The Technical Service issues a VCA 'job number' and informs the VCA so that they can commence Conformity of Production (CoP) assessment of the client.

https://doi.org/10.1017/S0373463300001181 Published online by Cambridge University Press

b. The client provides the documents specified in the relevant directive together with the required number of sample products for assessment and testing.
c. The client prepares a 'worst case' analysis of the product range.
d. This analysis is assessed in a 'worst case review' meeting with the Technical Service. A documented worst case assessment is produced for the VCA as a record of the agreement. The test plan is finalised and the Type Approval fees are confirmed.
e. Testing is carried out on the sample product(s) with the Technical Service witnessing the test work as necessary. Each directive defines the permitted test methods and the test limits to be used for both vehicles and components for radiated immunity and for radiated emissions.
f. For radio systems, the client is required to provide evidence that, when transmitting, the radio will not affect the normal operation of a vehicle it is installed in.
g. Test reports are prepared and the Technical Service provides a complete set of technical documentation and test reports to the approval authority.

Subject to a satisfactory review of the submitted documents and CoP assessment, the VCA issues a type approval certificate which authorises the manufacturer to put the 'e' mark on the product(s), or the 'E' mark where the approval is to an ECE Regulation.

4. EMC APPROVAL OF VEHICLES NOT COVERED BY DIRECTIVES. The scope of the specific vehicle directives listed above are such that all vehicles are not within their scopes. Examples of this are tracked vehicles, excavators, and construction equipment.

At present, normalized European standards (ENs) do not exist that are appropriate for all vehicles/equipment subject to assessment under 89/336/EEC. The Technical Construction File identified in 89/336/EEC provides the route by which the requirements of vehicle EMC directives and those of other relevant international standards for a vehicle's EMC environment may be used to show compliance with 89/336/EEC. The EMC Competent Body now has specific guidance available from ISO 13766 for excavators and EN 13309 for construction equipment. EN ISO 14982 covers forestry and agricultural tractors not included in the scope of directive 75/322/EEC as well as a wide range of agricultural equipment. Manufacturers may 'CE' mark tracked forestry and agricultural tractors and all kinds of mobile (including hand held) agricultural machinery, forestry machinery, landscaping and gardening machinery, by testing to, and declaring compliance with, this standard.

5. RADIO APPROVAL. Until 8 April 2000, the control of the radio spectrum in each country in the world was subject to national approval. There was some agreement in Europe on the utilisation of the RF spectrum, but it was not complete. Naturally, this created difficulties for manufacturers of products that had Europe-wide, and greater, application. Mobile phones are an example of this. Vehicle telematic systems that required a radio link were also subject to the need for individual national approvals.

The speed of new product development resulted in problems with the old radio type approval system, as it added significant delays to placing a product on the market and

https://doi.org/10.1017/S0373463300001181 Published online by Cambridge University Press

even required different products for adjacent European countries. The European radio approval procedures were changed from national type approval to a self-declaration CE marking procedure with European acceptance from 8 April 2000. A radio Notified Body is required to advise on radio system testing where harmonised standards do not exist, and to review the resulting Technical Construction Files. At present, there are few harmonised standards for radio equipment applicable under the Radio equipment & Telecommunications Terminal Equipment Directive (R&TTE). ETSI are writing new standards for performance of radio equipment. The result is a re-write of existing radio EN standards, and a set of new radio EMC overview standards. The relevant one for automotive Short Range Devices (SRDs) is EN 301 489 part 3.

Where the frequency band is not harmonised across Europe, it is necessary to notify the national radio approval authority in the country of sale of the intention to place the product on the market. Most vehicle radio systems are currently subject to Notified Body advice and review. For these systems, the CE mark is accompanied by the Notified Body number and also by an 'ALERT' symbol for non-harmonised frequency. This new marking is mandatory from 8 April 2001. Europe is now discussing harmonising some of the currently non-harmonised bands, but the timing is not defined.

The R&TTE directive specifically states, Article 1 paragraph 3, that approval to it is without prejudice to the requirements of automotive EMC approval. In effect, any radio system intended for use in a vehicle should meet automotive type approval requirements as well being 'CE' marked under R&TTE.

6. APPROVAL UNDER RTTE DIRECTIVE. After 8 April 2000, radio type approval is of the self declaration approach under one of the three following methods:

a. By declaration against harmonised standards, or, if an harmonised standard does not exist, against test methods advised by a 'Notified Body' under Annex 3 of the directive.
b. Manufacturers may choose to use a Technical Construction File for submission to a Notified Body who will have four weeks to issue an Opinion under Annex 4 of the directive. If the Notified Body does not issue an Opinion within four weeks, then the manufacturer is allowed to place the system on the market.
c. Where the manufacturer has a certified QA system in place, they may conduct their own testing and self-declare without reference to harmonised standards or the TCF route.

Important points from the R&TTE directive are:

a. EMC approval may be under articles 10.1 or 10.2 of 89/336/EEC or under R&TTE directive.
b. Where the RF band is not harmonised across Europe, the national radio approval bodies issue 'Interface Requirements' as advisory requirements for the radio system to meet.
c. Radio equipment using non-harmonised bands is required to carry an 'ALERT' symbol together with the 'CE' mark and the Notified Body number if applicable.

https://doi.org/10.1017/S0373463300001181 Published online by Cambridge University Press

d. Radio equipment intended for use in non-harmonised bands has to be notified to the national radio authority in the intended country of sale before it is placed on the market in that country.
e. The R&TTE directive requires a radio receiver for non-broadcast reception to be subject to R&TTE self-declaration.

7. CONCLUSIONS.

a. European vehicle EMC legislation covers all electrical and electronic equipment intended for fitment to a motor vehicle as well as the motor vehicle.
b. European vehicle EMC legislation covers after-market, as well as original fit, electrical and electronic equipment.
c. Radio approval under R&TTE is for spectrum management requirements.
d. All radio equipment has to comply with R&TTE directive from 8 April 2001.
e. Radio equipment for use in non-harmonised RF bands has to be marked with an 'ALERT' symbol.
f. Radio equipment for use in non-harmonised bands has to be notified to the national approval authority in the intended country of sale.
g. Both automotive EMC type approval and radio approval applies to radio equipment intended for use in a vehicle and both approval marks need to be applied.

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https://doi.org/10.1017/S0373463300001181 Published online by Cambridge University Press