

# EMC 2002

## INTERNATIONAL WROCLAW SYMPOSIUM AND EXHIBITION ON ELECTROMAGNETIC COMPATIBILITY

### AN EMC MARKET SURVEILLANCE PROJECT ON ENERGY-SAVING LAMPS IN FINLAND

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**Abstract:** The Safety Technology Authority (TUKES) organized EMC market surveillance tests on 36 energy-saving lamp models, according to the standard EN 55015. First of all, conducted disturbance emissions at mains ports were tested for. The first test results showed that 10 lamps out of 36 did not pass the tests and that there were serious defects in three lamp types. Surprisingly, defects were found to be equally distributed between inexpensive and expensive lamp models. Following this, 10 lamps were selected to undergo a magnetic disturbance test, but none failed. As well as this, the harmonic current emissions caused by energy-saving lamps are going to be tested in the near future.

In the product family standard for electrical lighting and similar equipment (EN 55015), there are no measuring methods available for testing radiated emissions. However, we intended to make radiated interference tests on some energy-saving lamps, according to the standard EN 55022. Our aim was to analyze the radiated interference levels of energy-saving lamps and to compare these with the interference levels permitted for other electrical products.

Also, four halogen floor lamps were tested and analyzed as a point of comparison.

**Keywords:** Energy-saving lamp, Halogen lamp, Market surveillance, and Self-ballasted lamp.

#### 1. INTRODUCTION

Products, services, labor and capital have freedom of movement within the EEA. National provisions for design or type examinations are considered to be technical barriers to trade. Manufacturers should ensure the compliance of their products and as a sign of this assurance their products should bear the CE-marking. The task of authorities is to supervise seeing that the products on the market fulfill the requirements that are relevant and have been stipulated. To this affect,

Finland too has aligned its electrical product surveillance.

The Safety Technology Authority (TUKES) has carried out the market surveillance of electrical products since the end of 1995. The focus has been on safety supervision but EMC surveillance too, has been regularly carried out since 1997. To date, TUKES's inspectors have carried out about 20,000 surveillance visits to commercial outlets, importers and manufacturers. During the period, inspectors have purchased more than 7,000 products for testing at competent laboratories. Most of the testing has been safety tests but the EMC properties of every product have, at least, been visually checked with EMC requirements in mind. About 400 product types were actually EMC tested.

EN 55015:1996 is the product family standard for electrical lighting and similar equipment. It contains no requirements for radiated emissions from 30 MHz to 1 GHz, unlike the generic standards and most of other product family standards. The Swedish Authority has found that at least some halogen lighting sets which are powered by an electronic transformer cause radiated emissions in frequencies not covered by EN 55015:1996. When they tested two different electronic transformers according to generic standard EN 50081-1:1992, they found that the apparatus exceeded the limit by 30 dB and 31 dB respectively at the same frequency 30.72 MHz, and the disturbance level was extensive up to 50 MHz.

#### 2. THE PROJECT

In 2001...2002 TUKES commenced an EMC market surveillance project on energy-saving lamps. Also, some halogen floor lamps were

tested and analyzed as a point of comparison. This project was the fourth EMC market surveillance project in Finland. The earlier subjects have been UPSs [1], PCs [2] and frequency converters [3].

The aim of this project was to find out the conformity of energy-saving lamps and to discourage non-conforming products from entering Finnish and EEA markets. Also, the adequacy of the standard EN 55015:1996 with regard to the conformity of energy-saving lamps within the terms of the EMC directive was evaluated.

## 2.1 Energy-saving lamps

A self-ballasted lamp has a ballasting and ignition circuit encapsulated in the lamp making one single unit. It is fitted with an Edison screw cap (E24 or E14) as in incandescent lamps. Commonly, it has been marketed as an energy-saving lamp because it consumes about six-times less energy than an incandescent lamp with the same light efficiency. Additionally, energy-saving lamps have a longer life. Energy-saving lamps are easily interchangeable with incandescent lamps. For this reason, these bulbs have become common in households, offices etc. At the same time, prices have fallen and selections have become more extensive.

An energy-saving lamp consists of built-in electronic ballast and a fluorescent tube. The ballast circuit converts the frequency of the fixed mains voltage (50 Hz) to the 20...30 kHz operating frequency of the fluorescence tube. A lamp switched on and using a high operating frequency, may cause electromagnetic interference. In fact, TUKES has received complaints concerning cases of interference caused by energy-saving lamps. Typical disturbed equipment has been, for example, the remote controls of TVs or local networks using power lines.

## 2.2 Test procedure

### 2.2.1 Market Surveillance Tests

There were altogether 180 lamps purchased for testing; five samples of each 36 lamp-model. The test procedure commenced with the conducted disturbance test. First of all, one lamp from every five lamp sample was tested at random. If the disturbances were below the limits of the standard to an extent

greater than the measuring uncertainty of the laboratory, the product was deemed to have passed the test. In such cases the other samples of that lamp type were not tested.

In the cases where disturbances were within measuring uncertainty range or above the upper limit of EN 55015:1996, A1:1997, A2:1999, the other four samples were tested. These four lamps were tested only in the frequency ranges where limits were overrun in the testing of the first sample. Following this, the statistical method for evaluating was used to determine the compliance of the product. The test results of the five lamp samples were calculated according to EN 55015 with the 80/80% rule.

Ten lamp models with results near the limits of the standard, or that had only minor defects, were selected to undergo a magnetic disturbance; a loop antenna test. At this stage, all five lamps of every lamp model were tested.

Accredited laboratories with Competent Body status carried out all the tests. The testing laboratories were Nemko Product Service, located in Finland, and Nemko AS in Norway.

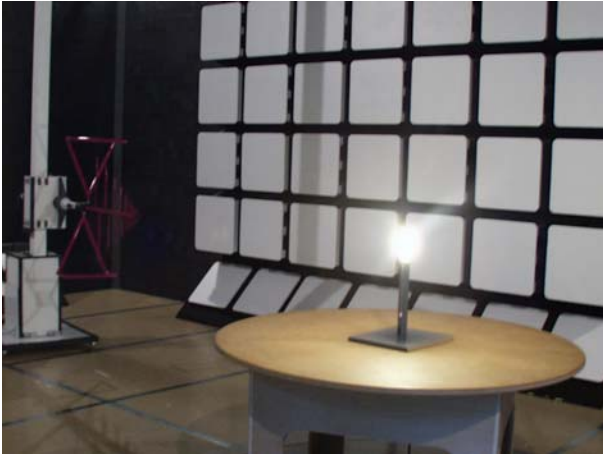
In March 2002, harmonic current emissions tests will be performed according to the test specification EN 61000-3-2, and the results will be available in time for the presentation of this paper.

### 2.2.2 Radiated Interference Tests

After the market surveillance tests, 25 lamps of the same lamp collection were delivered to undergo radiated interference testing. The Pohjois-Savo Polytechnic carried out these tests in Kuopio, Finland. The emission tests were performed according to the standard EN 55022:1998, A1: 2000, class B.

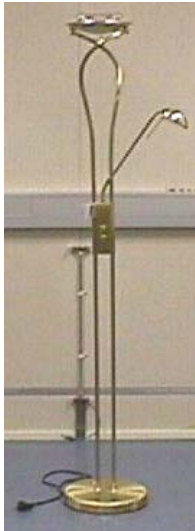
Test set-up (see Fig. 1):

- Tests were performed in a semi-anechoic shielded room at a measuring distance of three meters.
- The EUT was placed in the plastic lamp stand at a height of 1.15 m, on the turntable.
- The length of the power input cable was 1.50 m.
- If no defects were found, then only one lamp of each sample was tested.



**Fig.1 Radiated Interference Test Set-Up**

### 2.2.3 Tests for Halogen Floor Lamps



**Fig. 2 A Tested Halogen Floor lamp**

In January 2002, SGS Fimko Ltd, Helsinki, Finland, carried out EMC market surveillance tests for four halogen floor lamps as an assignment for TUKES. These floor lamps were equipped with one dimmable up-light halogen of 300 watts and one dimmable spotlight of 40...50 watts. Two models had a 12 VDC spotlight halogen, so in these cases also a transformer was used.

Test set-up:

- Conducted disturbances were tested according to EN 55015:1996, A1:1997, A2:1999.
- Harmonic current tests were carried out according to EN 61000-3-2:1995, A1:1998, A2:1998, A3:2000.
- Flickers were tested according to EN 61000-3-3:1995.

- From three floor lamps, radiated absorbing power from 30 MHz to 300 MHz was measured with an absorbing clamp according to EN 55014-1:1993, A1:1997, A2:1999.

## 3. RESULTS

### 3.1 Market Surveillance Tests

The EUT is described and test results are given in Table 1. The numerical values show how much the results were below (-) or above (+) the limit of EN 55015 and at which frequency the limits were overrun. Values are shown as quasi-peak (QP) or average (AV) values.

The test results show that 10 lamps out of 36 models did not pass the conducted disturbance test. There were serious defects found in three lamps. Surprisingly, defects were found to be equally distributed between inexpensive and expensive lamp models. In radiated magnetic disturbance tests, all 10 lamp-models easily passed the test.

Table 2 shows results from EMC market surveillance tests for energy-saving lamps carried out in Finland prior to this project. Table 3 shows the energy-saving lamp cases, which Sweden has notified according to the safeguard clause procedure of the EMC Directive. Other Member States of the EU have not notified any cases relating to energy-saving lamps.

### 3.2 Radiated Interference Tests

Table 4 shows results from radiated emission tests made for energy-saving lamps according to the standard EN 55022. All lamps easily passed the tests and the results were at least 10 dB below the limits of the standard.

### 3.3 Tests for Halogen Lighting Sets

In conducted disturbance testing and in flicker testing, all four halogen lighting sets passed the test. In radiated absorbing power testing, all three tested pieces of equipment easily passed the test. Instead, in harmonic current testing, serious defects were found in every tested halogen lighting set. At a certain dimming, all odd harmonic currents up to the 39<sup>th</sup> from every dimmer unit overran the limits of Class C of EN 61000-3-2. The total number of dimmer units was seven; three samples contained two dimmers each, and a set, one.

EUT (brand, type, electrical power, purchase price)				Emission Test Results EN 55015					Measure
				Mains terminal interference voltage 2			Radiated magnetic disturbance		
Brand	Type	Power (Watts)	Purchase price (EUR)	Pass/Fail	Frequency (MHz)	Margin (dB)	Pass/Fail	Margin (dB)	
Airam	Energyline	7	14.97	Pass	0.305/QP	-13.5	-	-	
Avec	FE27	15	4.88	Pass	0.936/QP	-8.4	-	-	
Belux	KLE	7	10.57	Pass	0.155/QP	-3.5	Pass	-20.60	
Brilliant		9	8.60	Fail	0.168/AV	+8.0	-	-	
Econlight		10	7.57	Fail	0.180/QP	+5.3	-	-	
Elettronica	Longlife	16	8.49	Pass	0.188/QP	-5.1	-	-	
Elman	DEF11-2U	11	4.88	Pass	0.188/AV	-3.6	Pass	-23.83	
Elman + sensor		9	11.60	Pass	0.009/QP	-44.4	-	-	
Energy + sensor		11	6.69	Pass	0.009/QP	-44.8	-	-	
Energy Saver	FF XEU 22	9	11.60	Pass	0.400/QP	-11.9	-	-	
Energy+		11	14.97	Pass	0.160/QP	-7.2	-	-	
Firefly		11	6.56	Fail	0.187/AV	+1.0	Pass	-19.63	
Fonlite		18	11.81	Fail	0.180/QP	+15.2	-	-	
Galux		15	11.46	Fail	0.217/QP	+22.6	-	-	
General Electric	DBX	11	11.60	Pass	0.488/QP	-5.8	Pass	-23.79	
Ikea	K511	11	13.29	Pass	0.150/QP	-3.4	Pass	-20.63	
JKRL 11W		11	5.80	Fail	0.165/QP	+3.4	-	-	
Leuci	Sirio/N	17	11.60	Pass	0.390/QP	-24.6	-	-	
Leuci IR	Gemini Sensor	16	18.33	Pass	0.009/QP	-44.4	-	-	
Lumex	E27-2U	11	3.36	Pass	0.165/QP	-9.5	-	-	
Lumine	EUS-11	11	6.56	Fail	0.177/QP	+5.8	Pass	-23.98	
Neolux	2817	13	5.61	Pass	0.318/QP	-3.1	Pass	-16.31	
Neonlite	E14	6	8.24	Pass	0.160/QP	-10	-	-	
Osolux		11	14.57	Pass	0.070/QP	-14.5	-	-	
Osram		11	3.74	Pass	0.185/QP	-7.0	-	-	
Panasonic		11	8.09	Pass	0.550/QP	-11.5	-	-	
Philips	Ecotone	11	4.20	Pass	0.375/QP	-9.2	-	-	
Powerlux		11	8.33	Fail	0.230/QP	+7.7	-	-	
Proman		20	5.89	Pass	0.500/QP	-10.8	-	-	
Proman		11	5.89	Pass	0.034/QP	-48.8	-	-	
Raven		11	3.33	Pass	0.160/QP	-2.7	Pass	-24.14	
Steinel		15	20.01	Pass	0.485/QP	-6.3	Pass	-23.71	
Sunlux		13	19.34	Pass	0.009/QP	-45.5	-	-	
Super Bright	ELR-11W	11	11.60	Fail	0.177/QP	+15.1	-	-	
Sylvania		15	8.33	Fail	0.160/QP	+3.2	Pass	-21.60	
Tungsrn	E4S	11	8.39	Pass	0.640/QP	-8.2	-	-	

**Table 1. Test Results**

Brand	Type	Power (Watts)	Test date	Pass/Fail	Frequency (MHz)	Margin (dB)	Measure
Osram	EL 15W	15	1994-09-01	Pass	-	-	
Nelux	14W	11	1994-09-09	Fail	?	?	
Econ Light	Econlight 10	10	1994-10-17	Pass	-	-	
GE	FLE15DBX	15	1994-10-26	Pass	-	-	
Inca	LVE11W	14	1994-11-08	Pass	-	-	
Vidilum	11W	11	1994-12-02	Pass	-	-	
Philips	PL Electronic-T	?	1997-07-03	Pass	-	-	
Semac	EVU 11W	11	1998-08-26	Pass	-	-	
Biltema	EL-19 (35-532)	19	1999-09-20	Fail	0.235/AV	+2.41	
Biltema	35-299	15	2000-09-22	Fail	0.360/AV	+10.27	Sales ban
Biltema	EL-5 (35-528)	5	2000-09-22	Fail	0.160/AV	+10.04	Sales ban
Biltema	EL-20(35-536)	20	2000-11-30	Fail	0.240/AV	+11.80	Sales ban
Ikea	003.999.00	4	2001-02-09	Pass	-	-	

**Table 2. Energy-Saving Lamps Tested prior to the Project**

Notification Country	Date	Brand	Type	Power (Watts)	Margin (dB)	Frequency (MHz)
Sweden	1999-07-21	Biltema	EL-20	20	+9.0	0.486/AV
Sweden	1999-07-21	Biltema	EL-19	19	+10.0	0.157/AV
Sweden	1999-12-17	Narva	Narvatronic	9	+7.0	0.164/QP
Sweden	1999-12-17	Stenb	EA-3	3	+14.0	0.157/QP
Sweden	1999-12-17	Fasett	E-boy	7	+21.0	0.164/AV
Sweden	2000-06-28	Biltema	35-299	15	+11.0	0.157/AV
Sweden	2000-06-28	Biltema	35-528	5	+11.0	0.150/AV
Sweden	2000-06-28	Starlux	MD8c	15	+14.0	0.206/AV

**Table 3. Notified Energy-Saving Lamps by Sweden**

EUT (brand, type)	Emission Test Results EN 55022 Class B, QP-values		
	Pass/Fail	Frequency (MHz)	Margin (dB)
Avec FE27	Pass	43.08	-10.20
Brilliant	Pass	-	noise
Elettronica Longlife	Pass	-	noise
Elman + sensor DEF11-2U	Pass	-	noise
Energy + sensor	Pass	-	noise
Energy Saver FF XEU 22	Pass	96.90	-13.60
Energy+	Pass	43.26	-14.90
Fonlite	Pass	97.14	-13.50
JKRL 11W	Pass	43.20	-11.70
Leuci Sirio/N	Pass	-	noise
Leuci IR Gemini Sensor	Pass	43.50	-19.50
Lumex E27-2U	Pass	96.84	-13.40
Neonlite E14	Pass	43.44	-18.90
Osolux	Pass	-	noise
Osram	Pass	-	noise
Panasonic EUS-11	Pass	42.48	-11.80
Philips Ecotone	Pass	-	noise
Powerlux	Pass	-	noise
Proman	Pass	43.14	-10.70
Proman	Pass	97.56	-13.10
Steinel	Pass	42.72	-10.50
Sunlux	Pass	-	noise
Super Bright ELR-11W	Pass	97.50	-12.70
Tungsram E4S	Pass	42.42	-10.40

**Table 4. Radiated Interference Test Results**

#### 4. DISCUSSION OF RESULTS

The results of this fourth EMC market surveillance project in Finland were better than we might have expected; 26 of 36 (72 %) tested energy-saving lamps fulfilled standards (the harmonic current tests are not ready yet). In the UPS project [1] the percentage value of fulfilled samples was 35 %, in the PC project

[2] only 8 %, and in the frequency converter project [3] 42 %. Only in four cases, emissions from energy-saving lamps were so high that we were obliged to restrict the distribution of the lamps; three sales bans, one delivery ban.

EN 55015:1995 contains no requirements for radiated emissions from 30 MHz to 1 GHz. According to our radiated interference measurements, this is not a problem in the case of energy-saving lamps, because all the tested lamps were more than 10 dB below the radiated emission limits of EN 55022:1998.

Seven halogen lighting set types have been notified about according to the safeguard clause procedure of the EMC Directive in 1999-2001. In all these cases, overruns of standard limits took place in disturbance voltage testing; from 12 dB to 37 dB. In Finland, two halogen sets were tested before the four cases described in this paper. In the prior tests, one set passed and the other had slight defects. The four halogen sets we tested in 2002, fulfilled all the other testing, but they had enormous difficulties with harmonic currents. According to measurements made by Swedish Authority, halogen lighting sets powered by an electronic transformer might cause radiated interferences. By absorbing clamp measurements, we did not find any notable radiated absorbing power values.

More and more of energy-saving lamp models are manufactured in the Far East. The same lamp model might be manufactured by several factories, and on the other hand, actually the same product might be offered for sale under different brand names. For example, a brand name owner for some energy-saving lamp models told us that if some of his lamps are found to be non-compliant, then he ordered the next production run of that lamp model from some other Far

Eastern factory. A serious problem seems to be that the energy-saving lamps originating from the Far East do not have uniform quality and quality can vary a lot between production runs.

An open European market makes the import business easy. It also tempts unskilled businessmen with dreams of big profits, and they usually do so-called 'one-off' business deals. They import a few containers of products from the Far East, distribute them quickly on the market, and then disappear. Such kinds of business change the price structure of the market, which impedes the operation of those importers who take care of their reputations by being responsible businesspersons.

Decisive factors for the safety and conformity of a product are the first controls made by the manufacturer and the carefulness and sense of responsibility of the importer. An experienced and responsible importer can have an especially big influence on the quality of products imported from the Far East. The high number of lamp and luminaire manufacturers in the Far East leads to competition between factories. There is a ready buyer's market and factories are prepared to do nearly anything in order to keep their clients satisfied. It became apparent from project interviews that the importer himself could mar the quality of products e.g. through over bargaining the price down too much. For example, not all importers learn to respect the emotive feelings behind Chinese business culture which does not permit them to be negative or say no!

## 5. CONCLUSION

The project showed that energy-saving lamps might cause interferences, especially conducted RF emissions. Anyhow, results were not as bad as might have been expected, with PCs and power electronic devices seeming to be more problematic cases.

According to this project, the radiated emissions above 30 MHz are not a complication for energy-saving lamps. On the other hand, for halogen lighting sets powered by electronic transformer, radiated emissions might be a serious problem.

From a market surveillance authority's point of view, it is very problematic that the quality of products varies so much between production runs. Energy-saving lamps come under this heading. We have noticed that the quality of inexpensive, in general Far Eastern made, energy-saving lamps varies a lot. After we have given a sales ban to a 'bad' production lot, the importer shows that the products have been altered and that now the product type is 'good'. Following this, we give permission for that product type to be sold. But no one knows what kind of products the next production run might carry!

## 6. REFERENCES

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## BIOGRAPHICAL NOTES



Jyri Rajamäki graduated from Helsinki University of Technology in 1991 where he specialized in power electronics. Since 1996, his main assignment has been to make the Finnish market ready for the EMC Directive.



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