



COMPLIANCE OF SMOKE ALARM DEVICES TO EN 14604 -
STATISTICAL ANALYSIS OF MARKET SURVEILLANCE RESULTS

Benoît Stockbroeckx
Head of Division Laboratory

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ANPI asbl - Parc scientifique Fleming
Granbonpré 1 - 1348 Louvain-la-Neuve
Belgique
info@anpi.be - www.anpi.eu

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ABSTRACT

60 different references of smoke alarm devices have been tested in the frame of market surveillance processes from several countries. The samples have been tested at ANPI according to EN14604 for 6 requirements: battery removal indication, marking and data, directional dependence, initial sensitivity, fire sensitivity, and sound output. The results have been statistically analysed along 2 axes: requirements and claimed certification scheme. The results provide the occurrence of non-compliances to the requirements. It appears that 33% of the sampled products are not compliant for at least 1 requirement; that 19% of the products have a problem with fire detection; and that products which claim to comply with at least one voluntary mark certification yield significant better results by a factor of 2 to 4 than these claiming CE only.





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1 INTRODUCTION

Several countries or regions in Europe have imposed or will soon impose by law the installation of smoke alarm devices in private homes. This has stimulated the activation of market surveillance processes for these products.

Smoke alarm devices are within the scope of the construction product regulation (CPR)[1]. An EC certificate of constancy of performance has to be issued by a notified body **prior to** selling the product on the European market. The harmonized standard for initial type testing and CE marking process is EN 14604:2005 + AC:2008[2]. The surveillance process required by the CE-CPR scheme is an annual audit of the quality system of the factory. No profound inspection of the product is required. Beyond this mandatory CE marking process exist several quality marks across Europe whose application must remain voluntary. These marks are supposed to be an added value to the CE marking, distinguishing the most qualitative products on the market. For all these marks one of the added requirements as compared to the CE-CPR scheme is the inspection of the product itself: sampling for comparison with the recorded technical file to detect potential undeclared modifications and periodical testing for some major requirements of the standard.

According to CPR requirements, the member states have to carry out a survey of the market by sampling products and performing selected laboratory tests. ANPI laboratory has been asked by a number of countries to be involved in this process. The collected data provides a significant amount of results reflecting the reality of the market.

The first section of this paper presents how the results have been gathered and a short description of the test objectives and requirements. The second section describes the

parameters used for the statistical analysis. The results of this analysis are discussed in the third section. Finally, the last section presents the conclusion and an explanation of the results.

For obvious confidentiality reasons, the product brands and references, the considered countries, and the test results will not be disclosed in this paper.

2 METHODOLOGY

Some Member States independently involved ANPI in their market surveillance process. The sampling has been achieved by the corresponding authorities within their territory. Each country has decided on a reduced test protocol based on the EN 14604 standard. The choice amongst all the requirements has been made by an educated guess. The focus has been on the core functionality of the devices and on requirements for an appropriate use of them:

- battery removal indication (§4.13), marking and data (§4.19), directional dependence (§5.3),
- initial sensitivity (§5.4),
- fire sensitivity (§5.15), and
- sound output (§5.17).

The objectives and requirements of these 6 clauses of the standard are summarized here.

- "battery removal indication": the user has to be warned when trying to install his device without a battery inside;
- "marking and data": a set of indications must appear on the product (recommended date for device replacement, recommended battery type, recommendation to test the device after battery replacement, etc.) and an accompanying documentation must for example guide the user during the installation and the maintenance of the device;
- "directional dependence": the sensitivity to smoke must be the



same over 360° around the device (the dependence to the direction of arrival of the smoke must be limited);

- "initial sensitivity": the manufacturer must be able to calibrate all the produced samples to the same sensitivity; during a normal certification process the sensitivity of 20 samples of the same model is measured and all the results must be similar (the set has been reduced to 5 samples in the frame of the market surveillance processes);

- "fire sensitivity": the devices must be able to produce an alarm when a fire is developing before the amount of smoke exceeds a high level; 4 types of fire are used: smouldering pyrolysis wood fire (TF2), glowing smouldering cotton fire (TF3), flaming plastics (polyurethane) fire (TF4) and flaming liquid (n-heptane) fire (TF5); this is of course to test the major core functionality of the device;

- "sound output": when producing an alarm the sound level must be sufficiently high but not too high and the frequency of the sound must be low enough.

ANPI laboratory is ISO 17025 accredited for all these tests.

3 PARAMETERS

The collected data have been statistically analysed. The analysis has been oriented along 2 orthogonal (independent) axes. The first axis is made up of the 6 different requirements. The occurrence of the non-compliances on each of these requirements has been calculated. This provides an overview of the flaws of the products available on the market. The second axis is made of the certification scheme claimed by the supplier of the device on his label. For one part of the products, CE is the only certification scheme claimed by the manufacturer. For the other part of the products, voluntary quality mark certificate is claimed in addition to the CE. The encountered

quality marks are well known European marks. The number of products shown as not compliant with at least 1 requirement has been calculated for both families of products. This provides an overview of the impact of the certification scheme on the compliance of the devices. Finally, a cross analysis combining these 2 axes has been done. This cross analysis provides an image of the distribution of the non-compliances according to these 2 orthogonal axes.

4 RESULTS STATISTICAL ANALYSIS

60 different references of smoke alarm devices sampled by the Member States have been tested during the past 2 years in our laboratory. All of them include an optical sensor. Products using the ionization detection principle have not been tested.

Requirement axis analysis results

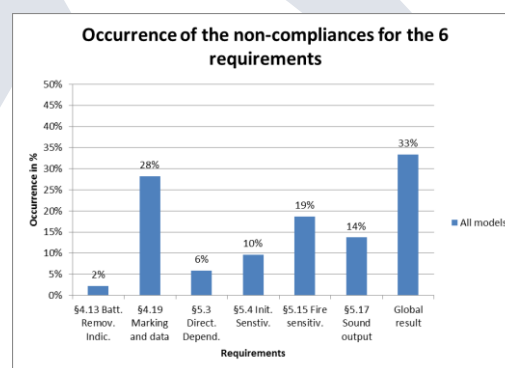


Fig. 1. Occurrence of the non-compliances for each considered requirement and for the 6 requirements altogether.

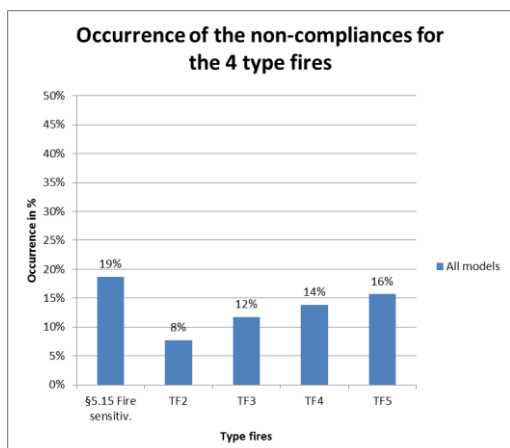


Fig. 2. Occurrence of the non-compliances for each of the 4 type fires and for the 4 fires altogether.

The non-compliances for each of the different considered requirements (first axis analysis) have been counted. The results are expressed as percentages in Figure 1. A first result shows that 33% of the products present at least one non-compliance. Most of these rely on the marking on the product or the instruction provided to the user. 19% of the products have a problem with fire detection.

The distribution of the non-compliances amongst the 4 types of fire is given in Figure 2. This indicates a statistical gradual difficulty of detection. TF5 (heptane flaming liquid fire) is the most difficult fire to detect for an optical sensor.

The third requirement giving a relatively high occurrence of non-compliance (14%) concerns the alarm sound output. The distribution of the non-compliances amongst the two sound parameters is shown in Figure 3. The sound level is too low for 8% of the sampled products. The sound frequency exceeds 3.5 kHz for 10% of the sampled products, but it remains very close to this limit.

10% of the sampled products are not compliant with the initial sensitivity requirements. It means that the five samples with the same product reference have not been tuned to

the same sensitivity by the manufacturer. The sensitivity of the products is not sufficiently isotropic for 6% of the references. Finally, the battery removal indication is not satisfactory in 2% of the cases.

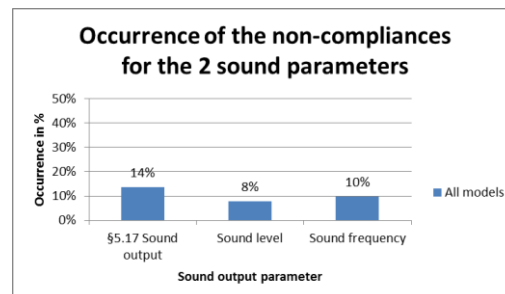


Fig. 3. Occurrence of the non-compliances for each of the 2 sound parameters and for the 2 parameters altogether.

Certification scheme axis analysis results

The second axis of this analysis investigates the occurrence of unsatisfactory products as a function of the claimed certification scheme. About half of the references claim a voluntary mark certification while those of the other half do not. The occurrence of the non-compliances for these 2 families of products is depicted in Figure 4. It appears from this analysis that 48% of the products sold without any voluntary mark above CE are not compliant with at least one of the 6 considered requirements. The result for the other family is significantly different: 21% of the products claiming a certificate of at least one voluntary mark are not compliant with at least one of the 6 considered requirements.

It has to be noted that 5% of the references do not claim CE certification at all. Two situations can be observed.

1. The product has been put on the European market (has left the factory) before August 1st 2008, the date CE certification according to EN 14604 became mandatory, and is still on the shelves.
2. The product is not legally put on the market.

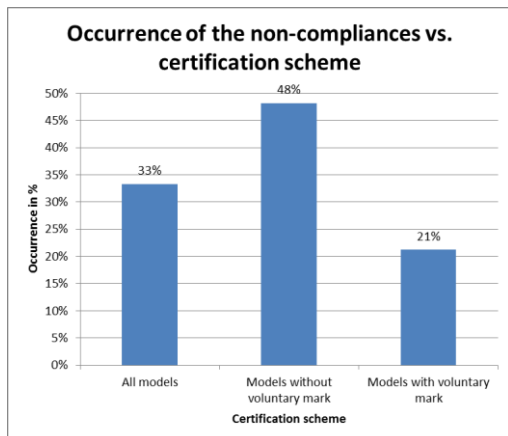


Fig. 4. Occurrence of the non-compliances for each of the 2 kinds of certification schemes and for the 2 kinds altogether.

Full analysis results

Counting the number of non-compliances for each combination of requirement and certification scheme provides the qualitative map depicted in Table 1 below. The disk surface is proportional to the occurrence of non-compliances for each combination. The improvement offered by the voluntary marks is obvious.

§4.13 Batt. Remov. Indic.			
§4.19 Marking and data			
§5.3 Direct. Depend.			
§5.4 Init. Sensitiv.			
§5.15 Fire sensitiv.			
§5.17 Sound output			
Global result			
	All models	Models without voluntary mark	Models with voluntary mark

Table 1. Qualitative overview of the distribution of the non-compliances for the 2 kinds of certification schemes.

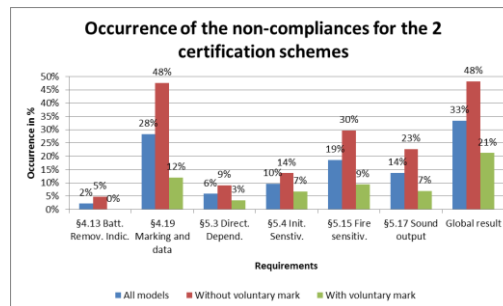


Fig. 5. Occurrence of the non-compliances to the 6 requirements, comparison for each of the 2 kinds of certification schemes.

Figure 5 provides a quantitative comparison of the two kinds of certification schemes. When paying attention to the core functions of the smoke alarm devices (fire sensitivity and sound output), the voluntary marks reduce by a factor of 3 the occurrence of the non-compliances.

5 CONCLUSION AND INTERPRETATION

When the European consumer buys a smoke alarm device which does not claim any voluntary mark the risk to get a product not complying with EN14604 is 1 in 2 and the risk to purchase a product having problems with fire detection is 3 in 10. When buying a product claiming a voluntary mark certification these risks become 1 in 5 and 1 in 10 respectively.

Considering the 6 requirements presented in this paper, the risk presented by the voluntary mark certified products is reduced by a factor of 2 to 4 when compared to CE-only products.

Even if the performance of the voluntary marks is not 100% (0% non-compliance), the improvement as compared to pure CE marking is significant.

The reason for such a result probably lies in the certification scheme applied by these voluntary marks. The scheme required by the CPR is not able to detect small modifications, having a strong impact on the product reliability, which



have not been declared. The voluntary marks compensate this lack with a stronger market surveillance scheme.

In this case study of smoke alarm devices, it can be observed that CE marking according to CPR is not a quality mark and the voluntary marks provide a significant added value towards reliability and quality.

REFERENCES

[1] "Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC ", Official Journal of the European Union, 2011, L 88, , April 4, pp 5-43

[2] CEN TC72, "EN14604: Smoke alarm devices", Brussels, Belgium, July 2005 and October 2008.

