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► **To cite this version:**

Ruddy Branka. Twelve years of fireworks market surveillance in France. 13. International Symposium on Fireworks, Apr 2012, Valletta, Malta. pp.58-66. ineris-00973660

**HAL Id: ineris-00973660**

**<https://hal-ineris.archives-ouvertes.fr/ineris-00973660>**

Submitted on 4 Apr 2014

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# **Twelve years of fireworks market surveillance in France**

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## **Abstract**

In the view of market surveillance, more than 4400 fireworks have been taken on the spot by sworn people or bought on the market in France since 1999 for inspection purposes.

This paper presents

- the market surveillance sampling evolution during 12 years, carried out by the PYRO unit of the Accidental Risks Division of INERIS as testing body,
- the related measures implemented: additional audits in importer plants, interlaboratory tests for guarantying the reliability of the results, EN17025 accreditation of the testing laboratory,
- the typology of detected defects,
- the results in terms of defects evolution trends versus time.

## **Introduction**

Directive 2007/23/EC of the European Parliament and of the council of 23 may 2007 on the placing on the market of pyrotechnic articles explains in its article 14 that Member States shall take all appropriate measures to ensure that pyrotechnic articles may be placed on the market only if, when properly stored and used for their intended purpose, they do not endanger the health and safety of persons. For these reasons, Member States shall carry out regular inspections of pyrotechnic articles on entry into the Community and at storage and manufacturing sites.

Even if certified fireworks are not yet completely on the way, these articles are put on the French market (French approvals remain applicable until July 4<sup>th</sup>, 2013), a procedure has been put in place in France in order to withdraw an article from the market if it does not comply with the French safety rules (French decree n°2010-455 of May 4<sup>th</sup>, 2010). This procedure will be continued after the putting in place and the application of the newly introduced certification (CE marking) rules.

## **Control rules**

In the target of market surveillance, INERIS began to take samples for inspection purposes on the market as early as 1998 on explosives and from 1999 on fireworks and pyrotechnic articles.

The sampling procedure changes in 2010. From 1999 until 2009, the sampling was made by sworn peoples directly in the importer's warehouses. Due to difficulties to obtain the suitable quantities of same articles, since year 2010, articles are bought on the market (chosen by INERIS in catalogues or Internet sites, and after validation of choices by the French administration).

Additionally, from 2008 to 2010, INERIS performed audits within the importers (in the same time that the sampling) in the view of giving an opinion about the procedures applied by each importer to guarantee the full compliance of the imported articles with the original agreed products.

All controls are financed by the French administration and performed by the explosives testing body of INERIS (the PYRO unit).

## **Actual procedure initiated in 2012**

A list of articles (currently, 100 per year from 2010 until 2014) is proposed to the French administration. After validation, a sample of 12 items per type is bought on the market in the view of their control (1 is disassembled, 10 are tested and 1 is kept as witness model).

Among these samples, 20 pyrotechnic compositions are chosen and collected in the view of their analysis.

A report, giving the disassembly results in terms of dimensions, angles and net weight, the functioning tests results and a comparison with the original test results obtained when the approval was delivered (INERIS has in charge to keep all these files) is produced per type of article selected.

The final report for each type controlled summarizes information about all detected non conformities, classified in 2 sub categories;

- Level I non conformities: all criteria including a risk for the users
- Level II non conformities: all differences with the original file without any risk for the users

In brief, the main level I non conformities examined are presented in table 1.

Difference of bursting height modifying the safety distance for the public, or with average difference more than 20%
Ignition phase out of the critical limits
Noise level more than 161 dB lin pic at 2.38m (French regulation for bangers), or more than 10 dB from the original file
Dangerous functioning or debris
Pyrotechnic composition analysis with forbidden substances or false
Dangerous modification of dimensions of angles (i.e. for fan shaped batteries)
Difference of net weight more than 50% (20% for flash compositions)
Bad safety distance on labelling
Composition leakage

Tab.1: Level I non conformity typology

## The actions implemented

INERIS is certified according to the ISO9001 standard and, additionally, the PYRO unit is accredited according to EN17025 standard since 1995 for testing explosives and fireworks in the view of their approval or for classification to transport of dangerous goods. These certification and accreditation guarantee the competence of the operators and the quality of the reporting.

To ensure quality of the results versus time, The PYRO unit organizes periodically interlaboratory tests involving the other accredited French laboratories for these tests. In 1996, test results on noise level of bangers were obtained with 6 laboratories, including 2 European labs. In 2006, 2009 and 2011, tests were done only with French labs.

Year	number of labs involved	INERIS results (maximum difference between INERIS average and all labs average, in numbers of standard deviation)				
		bangers cat.1 at 1m, noise level in dBAI	bangers cat 2 at 8m, noise level in dBAI	bangers cat 2 at 15 m, noise level in dBAI	bangers cat 3 at 8 m, noise level in dBAI	bangers cat3 at 15 m, noise level in dBAI
1996	6 <sup>(1)</sup>	-1.11	-1.78	-0.32	-0.64	+0.09
2006	4 <sup>(2)</sup>	bangers duration of initial phase	bangers at 2,38m, noise level in dBlinpic	75mm shells bursting height	roman candles, bursting height	
		-0.09	+0.06	-0.46	-0.14	
2009	5 <sup>(3)</sup>	bangers noise level in dBlinpic	75mm shells bursting height	100mm shells bursting height	125mm shells bursting height	40mm roman candles bursting height
		-0.07	-0.07	+0.2	+0.17	+0.13
2011	5 <sup>(3)</sup>	bangers duration of initial phase	bangers noise level in dBlinpic	75mm shells bursting height	30mm batteries bursting height	30mm roman candles bursting height
		+0.12	+0.15	-0.62	+0.92	+0.85

Tab.2: Interlaboratory tests on fireworks testing

The above table give the results of the PYRO unit compared to the other laboratories, in terms of difference between the average of results pertaining to INERIS only compared to the average pertaining to all laboratory test results expressed, in numbers of standard deviations.

Except 2 values, INERIS results show limited deviations compared to overall mean laboratories values, e.g. as low as less than 1 standard deviation. These results attest for the high performance and the competence of the INERIS operators.

### Evolution of the sampling typology versus time

The following table gives, for each year since 1999, the number and types of fireworks sampled for market surveillance. To some extent these variation reflect the French market trends evolution as well as intensification of market surveillance by the authorities.

year	shells	roman candles batteries and combinations	shot tubes	fountains	aquatic	mines	bangers (flash, back powder, friction,	table bombs	bengals	rockets	sparklers	smoke	spinners	wheels party poppers, crackers, craking	flash pellets	total types sampled	total items sampled	
1999	3	3		1			1		1	1						10	256	
2000	1	2						1	1							5	77	
2001	3	1	1													5	44	
2002	3	1	1													6	75	
2003	1	1	1							1						4	40	
2004	4	1	2	1					1		1					10	135	
2005/2006	6		1				1									8	80	
2007	16	11	12	2	6		7	4	1	1						60	763	
2008	22	7	16	2	5	2	1	1	1	3						59	496	
2009	24	12	6	3	8		1	2	5	2		1				65	1045	
2010/2011	34	13	9	5	10		3	6	2	3	3	2	3	2	2	1	100	1408
<b>totals</b>	<b>117</b>	<b>52</b>	<b>48</b>	<b>15</b>	<b>30</b>	<b>2</b>	<b>11</b>	<b>14</b>	<b>6</b>	<b>15</b>	<b>8</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>332</b>	<b>4419</b>
<b>percentages</b>	<b>35,2</b>	<b>15,7</b>	<b>14,5</b>	<b>4,5</b>	<b>9,0</b>	<b>0,6</b>	<b>3,3</b>	<b>4,2</b>	<b>1,8</b>	<b>4,5</b>	<b>2,4</b>	<b>0,6</b>	<b>0,9</b>	<b>0,9</b>	<b>0,6</b>	<b>0,6</b>	<b>0,3</b>	

Tab.3: Sampling table

The evolution of total items sampled is given hereafter.

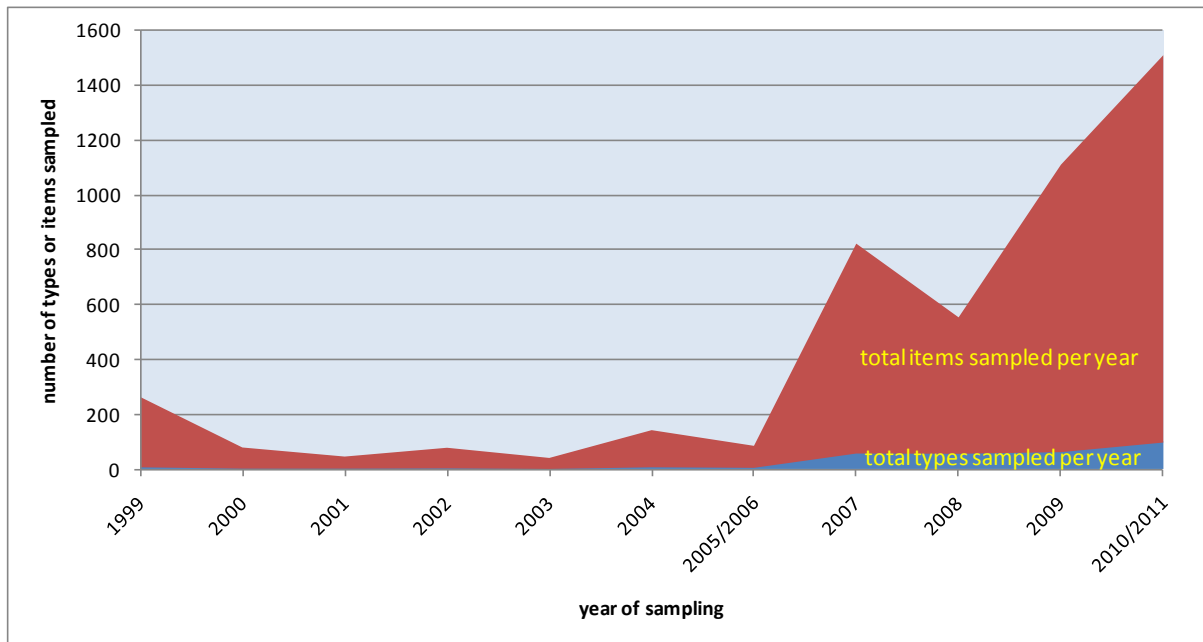


Fig.1: Sampling evolution

The scheduled sampling for the 3 next years is 100 types per year (from 1200 to 1500 items).

## Results in terms of conformity

The following table 3 gives, for each year since 1999, the number and percentages of non conforming and conforming products. Figure 2 gives the evolution of the percentage of compliance per year.

			non conformities (typology) in numbers of items						number of items acceptable and %
year of control	types sampled	items sampled	dimension, angle	net weight	ignition phase	functionning, debris, labeling	noise level	height of explosior	
1999	10	256		6	10			36	32 12,5
2000	5	77		10					67 87,0
2001	4	44						15	29 65,9
2002	6	75		40				10	35 46,7
2003	4	40		20		2		10	18 45,0
2004	10	135		45	15			10	80 59,3
2005/2006	8	80		30	30			20	30 37,5
2007	60	763	40	334	130	80	52	122	209 27,4
2008	59	496		134	12	22	46	158	289 58,3
2009	65	1045		379	208	36	140	224	366 35,0
2010-2011	100	1408	31	390	225	177	90	336	508 36,1
total (1)	331	4419	71 1,6	1388 31,4	630 14,3	317 7,2	328 7,4	941 21,3	1663 37,6

Tab.4: Non conformities statistics

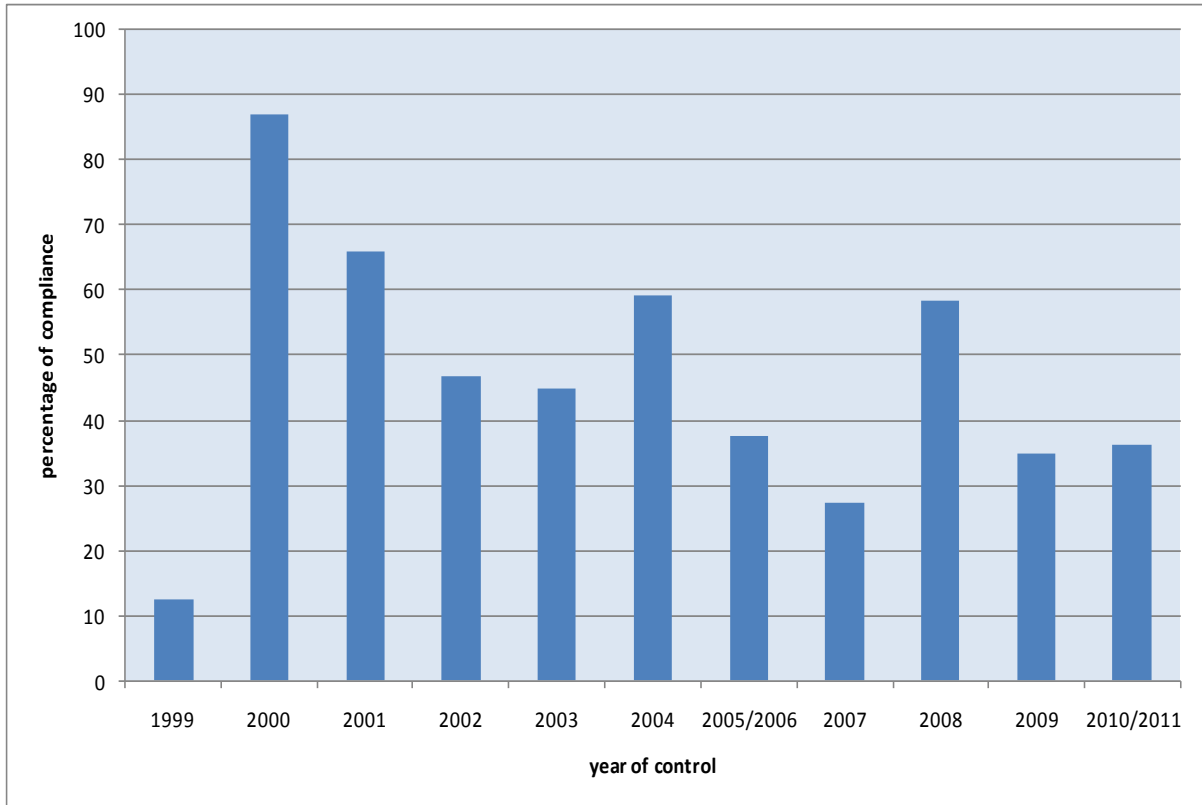


Fig.2: Evolution of the percentage of conformity per year

The main reasons of non conformities are presented in the following figure 3:

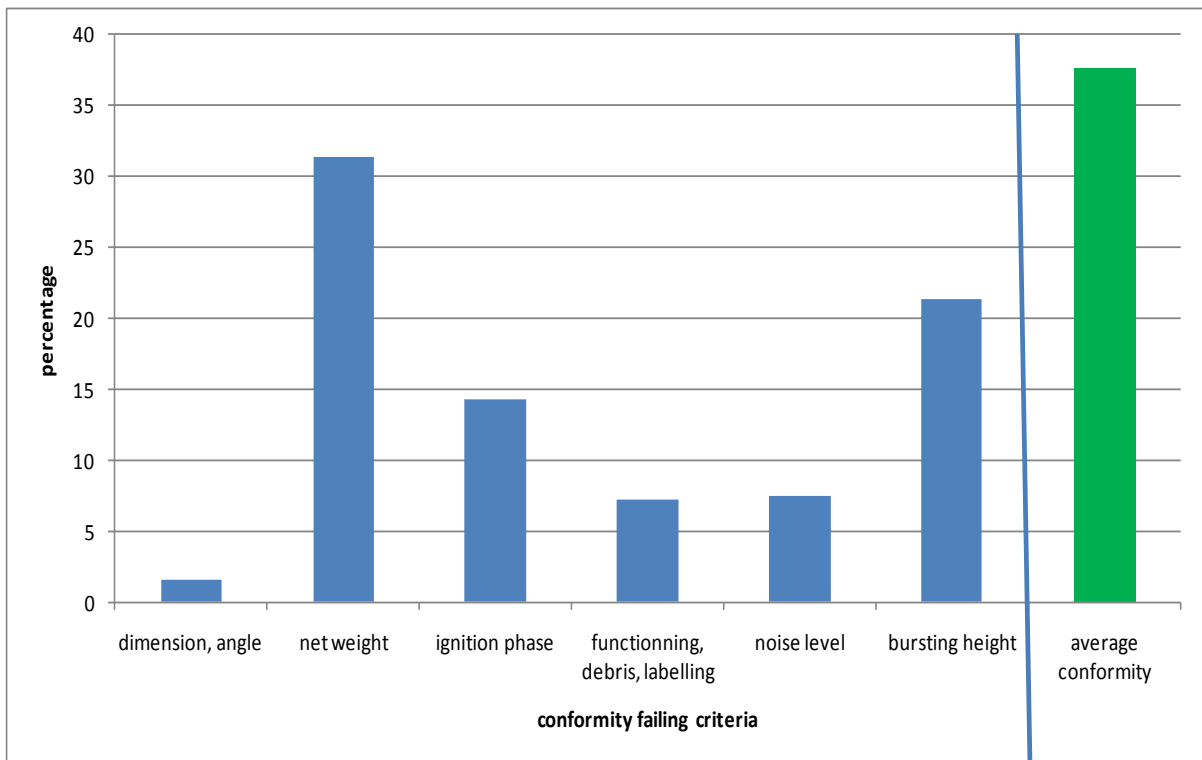


Fig.3: Distribution of non conformities

## Pyrotechnic composition statistical analysis

The following table present the number of pyrotechnic composition characterisations performed per year. Only 55% of the controlled compositions are acceptable.

year	number of compositions analyzed	number of conforming compositions
1999	2	0
2004	1	1
2005/2006	1	1
2007	10	1
2008	10	8
2009	8	3
2010/2011	20	15
total	52	29 (55%)

*Tab.5: Conformity of pyrotechnic compositions*

The purpose of the analysis is first to verify the absence of prohibited chemical compounds, and then to compare the results with the compositions reported in the initial approvals of the articles.

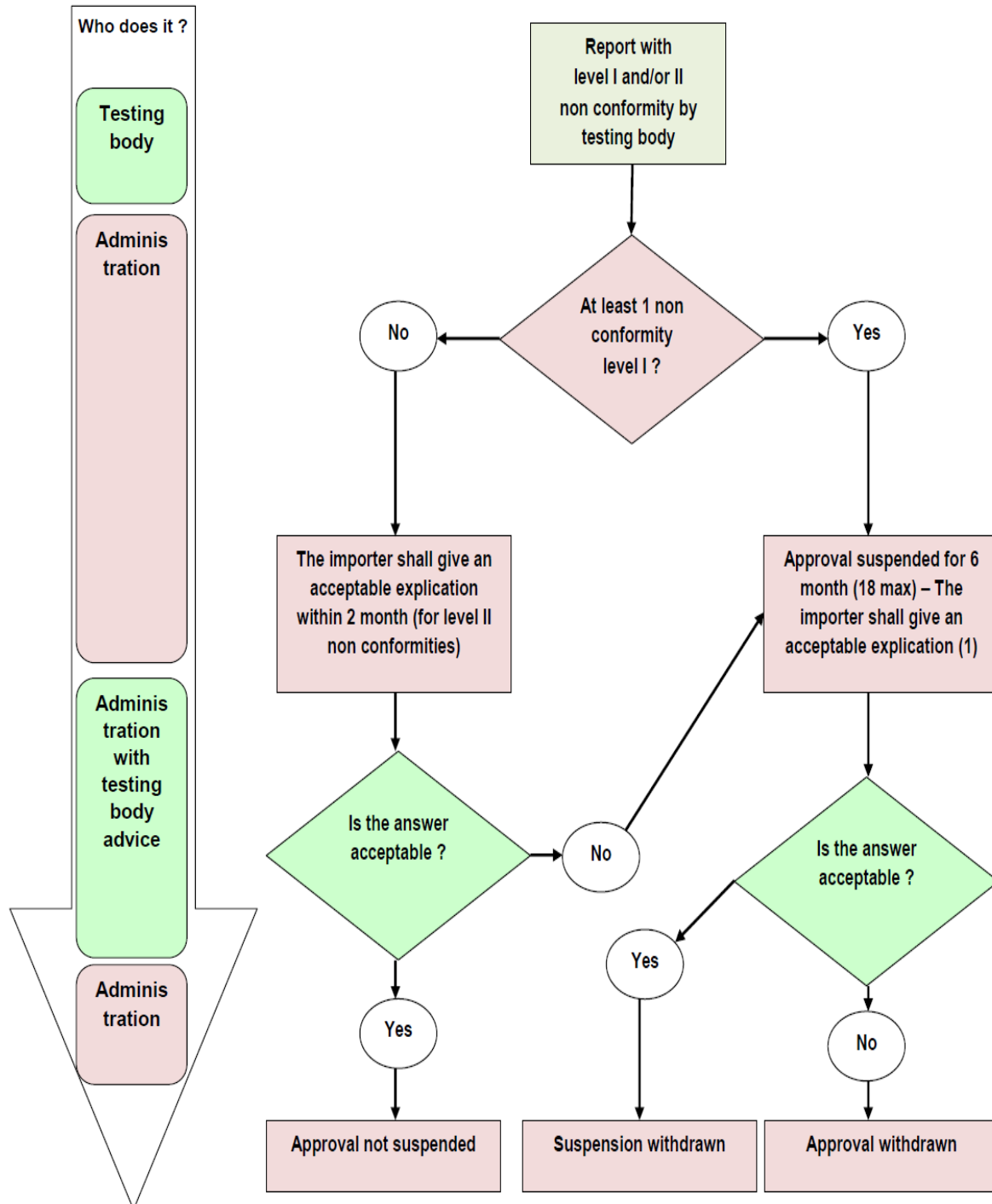
The results show the presence of chlorate in a banger composition (1999) or even the presence of chromium, lead, or HCB in various compositions in 2010.

The other detected non-complying compositions are mass contents of elements declared non-complying or presence of other compounds than those declared initially for approval.



## Withdrawal procedure of original approval

To date, 32 Fireworks among those sampled for inspection were the subject of a final withdrawal procedure, including 8 at the request of the importer itself. The procedure lies as follows:



(1) The 6 month suspension can be renewed if additional tests are required.

## **Conclusion**

As resulting of the poor quality of the products placed on the French market (the very high requirements in the criteria for the monitoring of the market may also have influenced their decision), the French competent authority has reinforced the inspection procedure.

Among the visible signs of this strategy, we may quote the increase of the sampling quantity, the fact that articles for sampling are anonymously purchased on the inner market, the request for systematic analysis of pyrotechnic compositions and the regular recourse to suspension or withdrawal procedures.

However, despite the large number of non-compliant products detected, and after careful examination of their effects and their importance according to the importer and the necessary consecutive related technical adjustments, at the end, final withdrawal procedures remain limited.