

Joint Market Surveillance Actions on GPSD Products - JA 2016 (Grant Agreement N° 739851 - JA2016 - GPSD)

Risk Assessment of Fireworks

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Disclaimer

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1 Introduction

The purpose of this document is to provide guidance to market surveillance authorities in assessing risks arising from non-compliant fireworks using the method from the RAPEX guidelines (2010/15/EC, Annex I).

The document present risk assessments corresponding to the following non-compliances (referring to the harmonised standard EN 15947-5:2015):

- Clause 4.2 Length of handle (on sparklers)
- Clause 6.4 Fuse requirements, i.e. too short or too long fuse burn time.
- Clause 7.2.2 Functioning, i.e. the firework doesn't ignite.
- Clause 7.2.3 Angle of ascent or flight, i.e. the fireworks does not ascend vertically.
- Clause 7.2.5 Stability during functioning, i.e. the firework tips over while working.
- Clause 7.2.6 Height of explosion, i.e. the pyrotechnic effect explodes in a too low altitude.
- Clause 7.2.7 Sound pressure level, i.e. the firework produces too loud sounds.
- Clause 7.2.8 Explosion and other failures.
- Clause 7.2.9 Burning or incandescent matter, i.e. fragments from the firework falls burning to the ground.
- Clause 7.2.11 Projected debris, i.e. fragments that are projected from the firework.

The guideline is based on scenarios that were discussed by the participants in the Fireworks Activities in the two Joint Market Surveillance Actions 2011 and 2014.

2 How to use this guideline

The risk assessor should start by identifying the non-compliances with the particular firework according to EN 15947-5:2015. This will normally be done through a laboratory test.

For each non-compliance, the relevant risk assessment can be identified from the table in chapter 3.1. The table refers to generic risk assessments in chapter 3 for seven types of fireworks and eleven non-compliances that have been identified as particularly common and risky during the work in the Fireworks Activities in JA2011 and JA2014. These combine to 15 different risk assessments.

Each row in the table lists a type of firework.

Each column list a type of non-compliance.

The cells reference a risk assessment with a scenario. The information in the risk assessment must be adjusted to the actual case. It can be inserted in the RAG tool (<https://ec.europa.eu/consumers/consumer-safety/rag/#/screen/home>)

3 Risk assessment and scenarios

3.1 Table

The figures in the table refer to subsequent chapters with the risk assessments

Type of firework	Non-compliance (EN 15947-2-5:2015)										
	Clause										
	4.2 Length of handle	6.4 Fuse req. too fast too slow		7.2.2 Functioning	7.2.3 Angle of ascent or flight	7.2.5 Stability during functioning	7.2.6 Height of explosion	7.2.7 Sound pressure level	7.2.8 Explosion and other failures	7.2.9 Burning or incand. matter	7.2.11 Projected debris
Bangers and flash bangers		3.3	3.5	3.7				3.12		3.14	3.16
Batteries and combinations		3.4	3.6	3.8		3.10	3.11	3.12	3.13	3.14	3.16
Fountains		3.4	3.6	3.8		3.10		3.12	3.13	3.14	
Ground spinners		3.4	3.6	3.8				3.12	3.13	3.14	3.16
Rockets		3.4	3.6	3.8	3.9		3.11	3.12		3.14	3.15
Roman candles		3.4	3.6	3.8		3.10	3.11	3.12		3.14	
Sparklers	3.2										

3.2 Non-compliance according to clause 4.2 Length of handle

- Non-conformity: The handle on the sparkler is shorter than 75 mm
- Hazard group: Extreme temperatures.
- Hazard type: Burns.
- Consumer type: Young children (older than 36 months and younger than 8 years - vulnerable consumers).
- Injury scenario: The sparkler is non-compliant as the handle is too short. A child holds the burning sparkler. The handle gets hot. The child has palm and fingers burned.
- Injury: Burns.
- Injury level: Level 1. (First degree burns up to 100% of body surface.)
- Steps to injury: Step 1: The sparkler is non-compliant as the handle is too short.
Step 2: A child holds the burning sparkler.
Step 3: The handle gets hot.
Step 4: The child has palm and fingers burned.
- Hints:
- A slightly different scenario could be imagined whereby the sparks cause fire damage to property in the house. It seems reasonable to assume that the fire is quickly extinguished so the harm would be limited to few pieces of furniture corresponding to a harm level of 1.

3.3 Non-compliance according to clause 6.4 Fuse requirements - bangers - too short fuse time

- Non-conformity: The fuse time of the banger is too short.
- Hazard group: Kinetic energy.
- Hazard type: Noise.
- Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
- Injury scenario: A person places a non-compliant banger on the ground, ignites it and walks away. The fuse finishes quicker than anticipated so the banger explodes before the person has reached the safety distance. The user suffers a hearing damage due to the noise level.
- Injury: Hearing injury.
- Injury level: Level 2. (Temporary impairment of hearing.)
- Steps to injury: Step 1: A person places a non-compliant banger on the ground, ignites it and walks away.
Step 2: The fuse finishes quicker than anticipated so the banger explodes before the person has reached the safety distance.
Step 3: The user suffers a hearing damage due to the noise level.
- Hints:
- The injury level and the probability for the actual injury is determined by the burning time of the fuse, i.e. how far the user can be anticipated to be from the banger when it explodes.
 - Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.4 Non-compliance according to clause 6.4 Fuse requirements - other fireworks - too short fuse time

- Non-conformity: The firework doesn't start when the fuse has burned out.
- Hazard group: Fire and explosion.
- Hazard type: Explosive mixtures.
- Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
- Injury scenario: A person ignites a non-compliant firework and walks away. The fuse burns quicker than anticipated so the firework begins to function before the person has reached the safety distance. The user turns around as a reflex action and is hit in his eye by fragments from the firework.
- Injury: Eye injury, foreign body in eye
- Injury level: Level 3. (Partial loss of sight, permanent loss of sight on one eye.)
- Steps to injury: Step 1: A person ignites a non-compliant firework and walks away.
Step 2: The fuse burns quicker than anticipated so the firework begins to function before the person has reached the safety distance.
Step 3: The user turns around as a reflex action.
Step 4: Fragments from the explosion hits the user in the face and one eye is damaged.
- Hints:
- Step 4 may have other outcomes. The scenario should be drafted in accordance with the observations from the laboratory test.
 - The probabilities should be estimated based on the observations in the laboratory test.

3.5 Non-compliance according to clause 6.4 Fuse requirements - bangers - too long fuse time

- Non-conformity: The banger doesn't work when the fuse has burned out but with a delay of some seconds.
- Hazard group: Kinetic energy.
- Hazard type: Noise.
- Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
- Injury scenario: A person ignites a non-compliant banger and throws it away from himself. The banger does not explode when the fuse has finished burning. The user walks to the banger. It explodes when the user is nearby. The user suffers a hearing damage due to the noise level.
- Injury: Hearing injury.
- Injury level: Level 3. (Partial loss of hearing, complete loss of hearing on one ear.)
- Steps to injury: Step 1: A person ignites a non-compliant banger and throws it away from himself.
Step 2: The banger does not explode when the fuse has finished burning.
Step 3: The user walks to the banger.
Step 4: It explodes when the user is nearby.
Step 5: The user suffers a hearing damage due to the noise level.

- Hints:
- The injury level and the probability for the actual injury is determined by the noise level of the banger and can be determined by examining the test results.
 - Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.6 Non-compliance according to clause 6.4 Fuse requirements - other fireworks - too long fuse time

Non-conformity: The firework doesn't start when the fuse has burned out.

Hazard group: Fire and explosion.

Hazard type: Explosive mixtures.

Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)

Injury scenario: A person ignites a non-compliant firework. The firework does not function when the fuse has finished burning. The user walks back to the firework. The firework begins to function when the user is nearby. The user is hit in the face and one eye is damaged.

Injury: Eye injury, foreign body in eye

Injury level: Level 3. (Partial loss of sight, permanent loss of sight on one eye.)

Steps to injury: Step 1: A person ignites a non-compliant firework.
Step 2: The firework does not function when the fuse has ended burning.
Step 3: The user walks back to the firework.
Step 4: The firework explodes when the user is nearby.
Step 5: Fragments from the explosion hits the user in the face and one eye is damaged.

- Hints:
- Step 4 may have other outcomes. The scenario should be drafted in accordance with the observations from the laboratory test.
 - The probabilities should be estimated based on the observations in the laboratory test.
 - The injury level and the probability for the actual injury in step 5 is determined by the nature of the non-compliance, the type of fireworks, the category, etc.

3.7 Non-compliance according to clause 7.2.2 Functioning - bangers

Non-conformity: The banger doesn't work when the fuse has burned out.

Hazard group: Kinetic energy.

Hazard type: Noise.

Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)

Injury scenario: A person ignites a non-compliant banger and throws it away from himself. The banger does not explode when the fuse has finished burning. The user walks to the banger. It explodes when the user is nearby. The user suffers a hearing damage due to the noise level.

Injury: Hearing injury.

Injury level: Level 3. (Partial loss of hearing, complete loss of hearing on one ear.)

Steps to injury: Step 1: A person ignites a non-compliant banger and throws it away from himself.
Step 2: The banger does not explode when the fuse has finished burning.
Step 3: The user walks to the banger.
Step 4: It explodes when the user is nearby.
Step 5: The user suffers a hearing damage due to the noise level.

Hints:

- The injury level and the probability for the actual injury is determined by the noise level of the banger and can be determined by examining the test results.
- Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.8 Non-compliance according to clause 7.2.2 Functioning - other fireworks

Non-conformity: The firework doesn't start when the fuse has burned out.
Hazard group: Fire and explosion.
Hazard type: Explosive mixtures.
Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario: A person ignites a non-compliant firework. The firework does not function when the fuse has finished burning. The user walks back to the firework. The firework explodes when the user is nearby. The user is hit in the face and one eye is damaged.
Injury: Eye injury, foreign body in eye
Injury level: Level 3. (Partial loss of sight, permanent loss of sight on one eye.)
Steps to injury: Step 1: A person ignites a non-compliant firework.
Step 2: The firework does not function when the fuse has ended burning.
Step 3: The user walks back to the firework.
Step 4: The firework explodes when the user is nearby.
Step 5: Fragments from the explosion hits the user in the face and one eye is damaged.
Hints:

- Step 4 may have other outcomes. The scenario should be drafted in accordance with the observations from the laboratory test.
- The probabilities should be estimated based on the observations in the laboratory test.
- The injury level and the probability for the actual injury in step 5 is determined by the nature of the non-compliance, the type of fireworks, the category, etc.

3.9 Non-compliance according to clause 7.2.3 Angle of ascent or flight

Non-conformity: The rocket does not ascend vertically.
Hazard group: Kinetic energy.
Hazard type: Noise.
Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario: A person ignites a non-compliant rocket. The rocket does not ascend vertically but flies in a low altitude trajectory over the spectators when it explodes. The user (or spectators) suffers from temporary impairment of hearing.

Injury:	Hearing injury.
Injury level:	Level 2. (Temporary impairment of hearing.)
Steps to injury:	Step 1: A person ignites a non-compliant rocket. Step 2: The rocket does not ascend vertically. Step 3: The rocket crosses over the spectators when it explodes. Step 4: The user (or spectators) suffers from temporary impairment of hearing.
Hints:	<ul style="list-style-type: none">• The probability that the rocket will explode at too low altitudes depends upon the level of non-conformity and can be estimated from the results from the laboratory test.• The injury level and the probability that the injury will occur depend upon the actual sound pressure level as measured in the laboratory test.• Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.10 Non-compliance according to clause 7.2.5 Stability during functioning

Non-conformity:	The firework (battery, combination, fountain or Roman candle) tips over while functioning.
Hazard group:	Kinetic energy.
Hazard type:	Moving product.
Consumer type:	Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario:	A person ignites a non-compliant firework. It tips over while it is functioning. Fragments, sparks or pyrotechnic units hit the user or nearby spectators and causes bruising.
Injury:	Bruising (abrasion/contusion, swelling, oedema).
Injury level:	Level 2 (major bruising, more than 25 cm ² on face or more than 50 cm ² on body).
Steps to injury:	Step 1: A person ignites a non-compliant battery, combination, fountain or Roman candle. Step 2: It tips over while it is functioning. Step 3: Fragments, sparks or pyrotechnic units hit the user or nearby spectators. Step 4: This causes bruising or wounds.
Hints	<ul style="list-style-type: none">• The probability that the firework will tip over depends upon how unstable it is. This can be estimated from observations during the laboratory test.• In case of batteries or combinations, the probability that fragments will hit the user or nearby spectators depends upon geometrical conditions like the distance between the battery and the victim and upon the number of shots that are fired after the battery has tipped.

3.11 Non-compliance according to clause 7.2.6 Height of explosion

Non-conformity:	Pyrotechnical effects ejected from the firework (or the firework itself in case of rockets) explode in a too low altitude.
Hazard group:	Kinetic energy.

Hazard type:	Noise.
Consumer type:	Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario:	A person ignites a non-compliant firework. At least one pyrotechnical effect explodes at a too low altitude. It produces a too high sound pressure level that causes temporary impairment of hearing to the user or spectators.
Injury:	Hearing injury.
Injury level:	Level 2. (Temporary impairment of hearing.)
Steps to injury:	Step 1: A person ignites a non-compliant firework. Step 2: At least one pyrotechnical effect explodes at a too low altitude. Step 3: It produces a too high sound pressure level that causes temporary impairment of hearing to the user or spectators.
Hints	<ul style="list-style-type: none">• The probability that pyrotechnical effect is released at a so low altitude that it will produce too high sound pressure levels can be estimated considering the results from the laboratory tests.• The injury level and the probability depends upon the actual sound pressure level as measured in the laboratory test.• Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.12 Non-compliance according to clause 7.2.7 Sound pressure level

Non-conformity:	The firework produces too loud sounds while functioning.
Hazard group:	Kinetic energy.
Hazard type:	Noise.
Consumer type:	Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario:	A person ignites a non-compliant firework. The firework explodes in the intended position or altitude, but it produces a sound pressure level above 120 dB(A). The user (or spectators) suffers from temporary impairment of hearing.
Injury:	Hearing injury.
Injury level:	Level 2. (Temporary impairment of hearing.)
Steps to injury:	Step 1: A person ignites a piece of non-compliant fireworks. Step 2: The firework produces a sound pressure level above 120 dB(A). Step 3: The user (or spectators) suffers from temporary impairment of hearing.
Hints	<ul style="list-style-type: none">• The probability that the firework produces too loud sounds can be estimated from the results in the laboratory test.• The injury level and the probability that the injury occurs depend upon the actual sound pressure level as measured in the laboratory test.• Guidance in assessing the risks due to loud noises can be sought in the guideline "Assessment of Risks from Acoustic Toys" that is uploaded to www.prosafe.org.

3.13 Non-compliance according to clause 7.2.8 Explosion and other failures

- Non-conformity: The firework (battery, combination, fountain or ground spinner) explodes while functioning.
- Hazard group: Kinetic energy.
- Hazard type: Moving product.
- Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
- Injury scenario: A group of people is watching a non-compliant firework. Suddenly it explodes. Fragments, sparks or pyrotechnic units hit the user or nearby spectators and causes bruising.
- Injury: Bruising (abrasion/contusion, swelling, oedema).
- Injury level: Level 2 (major bruising, more than 25 cm² on face or more than 50 cm² on body).
- Steps to injury: Step 1: A group of people are watching a non-compliant firework.
Step 2: It explodes over while it is functioning.
Step 3: Fragments, sparks or pyrotechnic units hit the user or nearby spectators.
Step 4: This causes bruising or wounds.
- Hints
- The probability that fragments will hit the user or nearby spectators depends upon geometrical conditions like the distance between the battery and the victim and upon the number of shots that are fired after the battery has tipped.

3.14 Non-Compliance according to clause 7.2.9 Burning or incandescent matter

- Non-conformity: Fragments from the firework fall burning to the ground.
- Hazard group: Extreme temperatures
- Hazard type: Open flames
- Consumer type: Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
- Injury scenario: A group of people is watching a non-compliant firework. Some of the pyrotechnical units fall burning to the ground. Some of these hit spectators and cause burns.
- Injury: Burn/Scald
- Injury level: Level 2 (2° burns on 6 - 15% of body surface).
- Steps to injury: Step 1: A group of people is watching a non-compliant firework.
Step 2: Some of the pyrotechnical units fall burning to the ground.
Step 3: The burning matter hits some of the people and causes light burns.
- Hints
- The probability that burning fragments are released and fall burning to the ground can be estimated from observations made during the laboratory test.
 - The injury level and the probability that it occurs depend upon the amount of burning matter as observed in the laboratory test.

3.15 Non-Compliance according to clause 7.2.11 Projected debris - rockets

- Non-conformity: The steering rod does not separate from the rocket engine, and the weight of rod plus motor are heavier than allowed.

Hazard group:	Kinetic energy.
Hazard type:	Moving product.
Consumer type:	Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario:	A person is igniting a non-compliant rocket. The steering rod and the engine don't separate when the pyrotechnical load explodes. The rod with engine falls from the sky and hits a spectator. The spectator suffers from bruising and laceration.
Injury:	Bruising or Laceration
Injury level:	Level 2 (major bruising > 25 cm ² on face or external deep cut > 5 cm on face).
Steps to injury:	Step 1: A person is igniting a non-compliant rocket. Step2: The steering rod and the engine don't separate when the pyrotechnical load explodes. Step 3: The rod with engine falls from the sky and hits a spectator. Step 4: The spectator suffers from bruising and laceration.
Hints	<ul style="list-style-type: none">• The probability that the steering rod and the engine separates can be estimated from the results from the laboratory test.• The injury level and the probability that it occurs depend upon the weight of the rod plus rocket engine.

3.16 Non-Compliance according to clause 7.2.11 Projected debris - other fireworks

Non-conformity:	Fragments from the firework are projected outside the safety distance for the firework.
Hazard group:	Kinetic energy.
Hazard type:	Moving objects.
Consumer type:	Other consumers. (Consumers other than vulnerable or very vulnerable consumers.)
Injury scenario:	A group of people watches a non-compliant firework. Fragments are ejected from the firework. A fragment hits one from the group in the face and injures the person's eye.
Injury:	Eye injury, foreign body in eye
Injury level:	Level 3. (Partial loss of sight, permanent loss of sight on one eye.)
Steps to injury:	Step 1: A group of people watches a non-compliant firework. Step 2: Fragments are ejected from the firework. Step 3: A fragment hits one from the group in the face. Step 4: The object injures the person's eye.
Hints	<ul style="list-style-type: none">• The probabilities should be estimated based on the observations in the laboratory test.• The injury level and the probability for the actual injury in step 4 is determined by the nature of the non-compliance, the type of fireworks, the category, etc.

4 Concluding remarks

This document presents guidance and should be applied as such. Every case must be assessed carefully on its own allowing fully for the specific characteristics of the particular case.

The risk assessor should document all considerations and rationales carefully in the risk assessment report so others can understand the lines of thinking. Such explanations will also help the risk assessor if he has to explain the case at a later stage - for the economic operator or in a court case.

The documentation should also include the conclusions from a sensitivity analysis to show how sensitive the resulting risk level is to changes in the input parameters; how much can the probabilities change before the resulting risk level changes.

Draft for discussion