Pyrotechnic Families Guidance – Category F1-F3 fireworks

As stated in the Directive 2013/29/EU of the European parliament and of the council of 12 June 2013 on the making available on the market of pyrotechnic articles ('Whereas (45)'), groups of pyrotechnic articles that *are similar in design, function or behaviour* should be assessed by the notified bodies as product families.

Grouping fireworks into families for CE certification is outlined below.
The minimum Type Test requirements must be achieved in order for the families grouping guidance to be applied.

Definitions

Product family: Group of individual variants that are similar in design, function or behaviour (often referred to as a 'family').

Variant: Part of a product family with fixed characteristics of design, function or behaviour. Any change(s) of the fixed characteristics will lead to a new article, which could be considered as a new variant within the existing family. Differences in the number or arrangement of each colour effect in a variant are permitted, as long as identical colour compositions are used.

1.- Test requirements

The following requirements are applicable to all F1-F3 fireworks except Compound fireworks, which are discussed in section 1.2.

1.1 Type Test (see Module B in Annex II of 2013/29/EU)

Selecting variants from a pyrotechnic family in order to Type Test it is dependent on the number of variants within the family. Table 1 summarises the sampling regime.

It should be noted that this guidance indicates the MINIMUM sampling regime and that larger numbers of items may be tested if a Notified Body considers this necessary.

Assessment of families with more than 5 variants submitted in the initial assessment

Five 'benchmark' variants should be tested as in the case of a 5 variants family (see Table 1). These should represent the range of different variants within the family and would be expected to include the variant considered to be the 'worst case', i.e potentially poses the greatest hazard.

All other variants in the family must also be tested as indicated in Table 1. Where these variants differ significantly from the benchmark variants thermal and mechanical conditioning should also take place.

Assessment of variants for inclusion in an existing family

Five individual items of each variant shall be tested as received unless the variant differs significantly from the tested benchmark variants. In that case tests after thermal and mechanical conditioning should also be considered (see Table 1)

Table 1: Sampling Regime for Type Testing of Firework Families for CE Certification

Initial assessment of families with up to 5 variants						
	No. of variants per family	**No. of items to be tested per variant**				**Total no. items tested**
		As received	**Mechanically conditioned**	**Thermally conditioned**	**For dismantling**	
Benchmark variants	1	10	10	10	3	33
	2	5	5	5	1 or 2**	33
	3	3 or 4*	3 or 4*	3 or 4*	1	33
	4	2 or 3*	2 or 3*	2 or 3*	0 or 1	33
	5	2	2	2	0 or 1	33
Initial assessment of families with more than 5 variants: 5 benchmark variants shall be tested as above. Additional variants shall be tested as indicated below. **OR** **Assessment of additional variants to be added to an existing family. Perform testing as indicated below.**						
Consideration	**No. of items to be tested per variant**					
	As received	**Mechanically conditioned**	**Thermally conditioned**	**For dismantling**	**Total no. of additional items per variant**	
Variants with similar pyrotechnic composition to tested benchmark variants or where thermal and mechanical conditioning are otherwise not considered necessary.	5	0	0	0	5	
Variants with significantly different pyrotechnic composition to tested benchmark variants or where thermal and mechanical conditioning are otherwise considered necessary	1	2	2	0	5	
* with a mandatory total of 10 articles tested ** with a mandatory total of 3 articles dismantled						

1.2 Type Test for compound fireworks (see Module B in Annex II of 2013/29/EU)

All variants in a family must be tested.

Compound fireworks with the same fireworks fitted to the same type of base but arranged in a different order are not considered to be variants.

All components of compound fireworks are required to be individually CE certified. Consequently, the number of items of each variant that are required to be tested is reduced to three and variants are only tested “as received”, i.e. no mechanical or thermal conditioning is required.

1.3 End product tests (e.g. batch tests, see Modules C2, D, and E in Annex II of 2013/29/EU)

The concept of family grouping as defined in the EC type-examination process shall also be applied to end product tests.

It is expected that all variants in a product family are tested. Therefore, all variants shall be treated as individual production lots/batches.

2.- Grouping Fireworks into Families

2.1 - Requirements for grouping variants into a firework family (excluding Compound fireworks)

All variants of one family shall:

1. be of the same category,
2. be of the same generic type,
3. have similar design:

   3.1. Similar internal design, which means:

   3.1.1. Same means of ignition (see EN 15947 part 5 para.6.1.)

   3.1.2. Similar mechanism of pyrotechnic functioning.

   3.1.3. Similar type of pyrotechnic units.

   3.2. Similar external design (dimensions)[1]

   3.2.1. Similar external geometric shape (if this can have a significant effect on article stability)

   3.2.2. Similar dimensions (if this can have a significant effect on functional parameters)

4. have chemical (pyrotechnic) compositions with similar resulting effects[2].

2.2 - Requirements for grouping Compound firework variants into a firework family

All variants of one family shall:

1. be of the same category,
2. be of the same generic type,
3. have the same method of transmitting ignition between individual fireworks,
4. have similar mechanisms of pyrotechnic functioning,
5. have a similar number of individual items,
6. use the same type of base (same material, dimensions, shape),
7. Use the same type of attachment to fix the individual fireworks to the base.

[1] Calibre is not considered as a dimension parameter.

[2] This requirement is generally covered by similarity in pyrotechnic units (3.1.3), except for the thermal stability.

2.2.- Similar types of pyrotechnic units:

The type of pyrotechnic units found in a firework is closely linked with aspects that may influence whether grouping variants into families is appropriate, i.e. internal design, potential hazards of the firework and/or effect produced by the firework. The change of the type of pyrotechnic unit in a firework variant produces a new variant that may or may not be considered part of the same family. If the type of pyrotechnic unit is not similar enough (for example because of its potential hazard or the effect it produces) the new variant may not be considered as a part of the same family. In a similar way, if the change of the type of pyrotechnic unit is similar to the original then the new variant can be considered as part of the same family as the original.

In order to introduce a classification of the pyrotechnic units based on their design, potential hazard and effect, pyrotechnic units have been grouped on the basis of similarity.

In some cases (i.e. when the effect is generated by loose composition) the effect will not be produced by a pyrotechnic unit but it has been considered necessary to include it in the classification in order to cover as many foreseeable cases as possible.

For similar reasons non-pyrotechnic units have been included within this classification. By definition they are not pyrotechnic units but they are used in some fireworks and should be considered.

The following classification is considered appropriate for fireworks of Categories 1, 2 and 3. Pyrotechnic units are listed in order of increasing potential hazard:

- **Non-projected non-pyrotechnic units**

  Units are not pyrotechnic but are released from the firework with low kinetic energy as the principal effect (i.e. Christmas crackers and table bombs)

- **Loose composition (No report)**

  The firework is the pyrotechnic unit. It contains loose or micro-granulated pyrotechnic composition that produces pyrotechnic effects such as colour, smoke, sparks or other pyrotechnic effect with the exception of reports.

- **Projected non-pyrotechnic units**

  Units are not pyrotechnic but are projected from the firework as the principal effect (i.e. confetti and streamers mines)

- **Stars and comets.**

  Pressed or compacted pyrotechnic composition that when ignited produces a pyrotechnic effect. This group includes composition pressed into cases whose effect upon ignition is equal to the effect produced by a single star (i.e colour without self-propulsion).

- **Cartridge effects without report.**

  Cartridges, usually cylindrical in shape, loaded with pressed pyrotechnic composition, which upon ignition produce visual effects (Bengal, flare, colour flames, serpents), spinning (tourbillions), propulsion (motors, shooting stars) and/or aural effects (whistle, hummers). Final effects produced by the cartridge may be a combination of effects i.e. aural effects with propulsion and colour but no report

- **Cartridge effects with report**

  Same cartridges as the previous case with the difference that they are loaded with loose composition (i.e: flash composition) which upon ignition produces a report usually as the ending effect.

- **Descending units (parachutes and similar)**

  Pyrotechnic units whose functioning is based on a fall slowed down by the design of the pyrotechnical units or the use of parachutes or other items. This kind of pyrotechnic units may travel a longer way from the ignition point than the other kind of pyrotechnic units.

- **Complex pyrotechnic units with bursting charge.**

  Pyrotechnic units that produce a bursting effect after a delay period followed by propulsion of secondary pyrotechnic units or burning fragments of the main pyrotechnic unit when the unit bursts.

- **Report composition.**

  The firework is the pyrotechnic unit. It contains loose pyrotechnic composition whose effect is a report.

Table 2 gives an overview of the subdivision of a group of variants (of a generic type of firework included in the same category) into different families based on the "*similar types of pyrotechnic units*" criterion. Table 3 provides examples of variants that can and cannot be grouped into a family.

Table 2: Different types of pyrotechnic unit for use in establishing firework families

Group	Principal Pyrotechnic Unit	Secondary Pyrotechnic unit
1	Non-projected Non-pyrotechnic units	N.A
2	Loose composition (No report)	N.A
3	Projected Non-pyrotechnic units	N.A
4	Stars and comets	N.A
5	Cartridge effects without report	N.A
6	Cartridge effects with report	N.A
7	Descending units (parachutes and similar)	N.A
8	Complex pyrotechnic units with bursting charge	Non-projected Non-pyrotechnic units
9		Loose composition (No report)
10		Stars and comets
11		Projected Non-pyrotechnic units
12		Cartridge effects without report
13		Cartridge effects with report
14		Descending units (parachutes and similar)
15		Report composition
16	Report composition	N.A

Table 3: Examples of variants showing whether family grouping is allowed

	Example	Can they be considered within the same family?
1	Cylindrical **banger** 'A' contains 5g blackpowder. Banger 'B' is identical except it contains 7g blackpowder.	No
2	Cylindrical **fountain** 'A' has a protruding fuse. Fountain 'B' is identical except it is fired using an electric igniter	No
3	Cylindrical **banger** 'A' contains 4g blackpowder. Banger 'B' is identical except it contains 4g flash composition.	No
4	**Shot tube battery** 'A' (16 shots with 4 different effects) and battery 'B' (same construction as battery A, but using only one of the effect types found in 'A'), are in the same Category (F2, F3). Battery 'A' has a different NEC to battery 'B'.	Yes
5	**Roman candle** 'A' and 'B' are identical except one has 8 shots, the other 12 shots	Yes
6	**Shot tube** 'A' contains a single star. Shot tune 'B' is identical except it contains a single bombette	No
7	**Shot tube battery** 'A' (16 shots, Size 100x100x120 mm, Cal. 18 mm) and battery "B" (16 shots, Size 150x150x150 mm, Cal. 27 mm). Both have similar pyrotechnic units and similar effects	No
8	Conical **fountain** 'A' with a diameter of the cone Ø 20/60 mm, 140 mm high (38g NEC). Conic fountain 'B' has the same NEC as 'A' but with an increased outside tube diameter (Ø 20/80 x 210 mm high).	Yes
9	**Shot tube battery '**A' (16 shots, Cal. 18 mm). Battery 'B' has same dimensions and number of shots but 27mm calibre tubes. Both have similar pyrotechnic units and similar effects	Yes
10	**Shot tube batteries** 'A' and 'B' are identical except one has a single initial fuse, the other has an initial and a reserve fuse of the same type as 'A'	Yes
11	**Shot tube batteries** 'A' and 'B' are identical except the firing order of 'B' is the mirror image of 'A'	Yes
12	**Shot tube batteries** 'A' and 'B' are identical except that the transmitting fuse in 'B' has been changed into two connecting fuses; an identical fuse with the same diameter was used.	Yes
13	Three **shot tube batteries** are identical except the tubes are arranged to produce a footprint that is triangular in 'A', square in 'B' and circular in 'C'.	No

	Example	Can they be considered within the same family?
14	Bengal stick 'A' has an NEC of 38g. Stick 'B' is identical except the NEC is 28g, which means the thickness of the composition is less than in 'A'	Yes
15	**Bengal stick** 'A' and 'B' are identical except the length of the uncoated end in 'A' is 90mm and in 'B' is 75mm	Yes
16	**Fountains** 'A' and 'B' have the same opening diameter and NEC but 'A' is cylindrical and 'B' is conical in shape	No
17	**Fountains** 'A' and 'B' are identical but 'B' has a thin card attached to the outside of the cylindrical tube to give it the appearance of a conical fountain (burning rate is not changed)	Yes
18	**Christmas cracker** "A" and a Christmas cracker "B" have similar snaps inside. Both have 1,2 mg of silver fulminate as report composition. The snaps differ in length from 280 mm and 150 mm. The outer diameter of Christmas cracker "A" can be measured as Ø35x280 mm and Christmas cracker "B" as Ø20x150 mm. [Comparable evaluations apply for **party poppers** (e.g. shape as a champagne bottle or cone shape) and **throw downs**.]	Yes
19	**Rockets '**A' and 'B' have the same type of rocket motor, stick and effect tube, but the bursting charge is different. 'A' has a bursting charge of 2g black powder whereas the bursting charge of 'B' is 1.8g flash composition.	No
20	**Rockets 'A' and 'B'** have the same type of rocket motor, stick and effect tube, but the effect charge is different. 'A' has an effect charge of green & blue stars; 'B' has an effect charge of yellow & red stars	Yes
21	**Bengal flame** "A" (NEC 18 g, colour red) and a Bengal flame "B" (NEC 18 g, colour green).	Yes
22	A 50 mm diameter **mine** 'A' has the same components in the same arrangement as a 100 mm mine 'B' but in smaller quantities, which means the NEC of 'A' is less than 'B'	No
23	**Shot tube battery** 'A' functions sequentially along a row of tubes before starting to fire the second row sequentially, this being repeated until the last row of tubes is reached. Battery 'B' fires a row of tubes on one side of the battery simultaneously followed by all the tubes on the other side of the battery.	Yes
24	**Bengal flames** 'A' and 'B' are identical except they produce different coloured flames and produce white or golden sparks	Yes
25	**Shot tubes** 'A' and 'B' differ only in the colour of the stars and whether they produce spark tips (white or golden)	Yes
26	**Roman candle** 'A' and 'B' differ only in the colour of the stars and whether they produce sparks	Yes

	Example	Can they be considered within the same family?
27	**Shot tube** 'A' and 'B' are identical except 'A' fires a crossette and 'B' fires a bombette	Yes
28	"**Shot tube battery** 'A' (9 shots with 3 different colours) and battery 'B' (same construction/dimensions and identical colour compositions as battery 'A', but differs only in the number of each colour or their arrangement inside the battery), are considered as the same variant."	Yes (and also the same variant)
29	**Compound firework** 1 uses only the existing initial and reserve fuses to connect the individual items. **Compound firework** 2 uses P1 fuse to connect all the items	N
30	**Compound firework** 1 and **Compound firework** 2 both use P1 fuse for connecting all items.	Y
31	**Compound firework** 1 uses P1 fuse to connect items A & B and existing fuse between items B & C. **Compound firework** 2 connects A & B with the existing fuse and B & C with P1 fuse.	Y
32	**Compound firework** 1 consists of a number of shot tube batteries only. **Compound firework** 2 consists of a number of rockets only	N
33	**Compound firework** 1 consists of 3 shot tube batteries. **Compound firework** 2 consists of 3 fountains	N
34	**Compound firework** 1 consists of 3 fountains. **Compound firework** 2 consists of a mixture of fountains and Bengal flames	Y
35	**Compound firework** 1 consists of 3 shot tube batteries. **Compound firework** 2 consists of 4 shot tube batteries (on an identical base)	Y
36	**Compound firework** 1 consists of 3 shot tube batteries. **Compound firework** 2 consists of 10 shot tube batteries (on an identical base)	N
37	**Compound firework** 1 consists of fireworks attached to a plywood base. **Compound firew**ork 2 consists of fireworks attached to a plastic base	N
38	**Compound firework** 1 consists of fireworks attached to a plywood base (600mmx600mmx6mm). **Compound firework** 2 consists of fireworks attached to a plywood base (1200mmx450mmx6mm).	N

	Example	Can they be considered within the same family?
39	Four different types of firework (A,B,C,D) have been CE certified and each one belongs to a family of similar variants. **Compound firework** 1 consists of one firework from each family (A1,B1,C1,D1). **Compound firework** 2 uses different variants from the same families (A2,B5,C3,D2). Both on identical base plates.	Y