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**COMMITTEE OF EXPERTS ON THE TRANSPORT OF  
DANGEROUS GOODS AND ON THE GLOBALLY  
HARMONIZED SYSTEM OF CLASSIFICATION  
AND LABELLING OF CHEMICALS**

Sub-Committee of Experts on the  
Transport of Dangerous Goods

Twenty-fifth session, 5-14 July 2004  
Item 3 (a) of the provisional agenda

EXPLOSIVES, SELF-REACTIVE SUBSTANCES AND ORGANIC PEROXIDES

Classification criteria for fireworks

Transmitted by the expert from the United Kingdom

**1. Introduction**

At the last meeting of the explosives working group (December 2003) the expert from the United Kingdom stated that he was carrying out a number of firework trials to help in developing the classification criteria for fireworks (see ST/SG/AC.10/C.3/48/Add.1). The United Kingdom has carried out Test Series 6 trials involving Roman candles and rockets without sticks and proposes criteria for their classification. The expert from the United Kingdom has further proposals for shells, shot tubes and wheels definitions.

**2. Roman Candles**

At the 21st session the expert from the United Kingdom gave details of a Test Series 6(c) trial on 29mm i.d. Roman candle that produced 1.4G effects (UN/SCETDG/21/INF.21). In response to questions about the level of flash composition in a Roman candle, the expert from the United Kingdom said that a Test Series 6(a) trial would be carried out on a Roman candle with flash composition units. This trial has now been completed on a firework called "8 Shot Bombette Salvo". Each Roman candle contained 8 lift charges (1.5g), and 8 effects consisting of stars (8g) and flash composition (2.5g). No explosion could be detected from the test, none of the confining material was moved by the ignition of fireworks nor was the witness plate deformed in any way. All the fireworks in the test were found to have fully functioned during the trial and this was confirmed by the thermocouple measurements made at the time of the test. The expert from the United Kingdom proposes that 30mm Roman candles with <25% flash composition cannot be considered as posing a mass explosion hazard.

The United Kingdom firework industry carried out a Test Series 6(c) trial on a 30mm Roman candle. The firework is one of the largest multi-shot Roman candle consumer fireworks on the United Kingdom market (BS Category 3 firework). The Roman candle consists of 7 effect units and these effect units contain less than 20g of pyrotechnic composition and a blackpowder lift charge of 2g. There were a total of 735 effects from 105 Roman candle tubes with a total NEC of 13.5kg pyrotechnic composition. The test showed that approximately 8% of the Roman candle effects were projected more than 15m over a 10 minute period and the majority of the effects were burning and decaying as soon as they were ejected from the firework. No perforations were made in the witness screens by the Roman candle effects. The expert from the United Kingdom proposes that Roman candles with an ID of  $\leq 30\text{mm}$ , with  $< 25\text{g}$  pyrotechnic composition and  $< 25\%$  flash composition per Roman candle effect, be classified as 1.4G.

### **3. Shot Tube**

A Test Series 6(a) trial has not been carried out on a shot tube firework since the density of pyrotechnic composition in the shot tube is considerably less than the Roman candle mentioned in paragraph 2 above. The expert from the United Kingdom proposes that shot tube fireworks with an ID  $\leq 30\text{mm}$  with  $< 25\%$  flash composition cannot be considered as posing a mass explosion hazard and suggests that the proposed 1.4G limits for Roman candles be applied to shot tube fireworks. A Test Series 6c trial on a shot tube firework will be carried out in the near future to support this classification.

### **4. Shells**

Some experts have suggested that as well as the diameter of the shell there should be an option to use the mass of pyrotechnic composition. In order to assist the development of the classification table a limiting quantity of 2100g is proposed as the criteria between HD 1.1G and HD 1.3G colour shells. This value comes from the test results from the 200mm Golden Willow colour shell presented by the Netherlands at a previous working group meeting (page 24, UN/SCETDG/21/INF.3). This data is included in the Annex table.

### **5. Wheels**

This classification has caused much discussion in the United Kingdom since it was included in the latest revision of the United Kingdom's firework classification list. The limit for both 1.3G and 1.4G wheels is set at 5g for each whistle. Above 5g for each whistle on a wheel means there is no classification definition and, unless test evidence is provided, the wheel defaults to 1.1G. The expert from the United Kingdom has had representations from professional display operators to re-examine the limit for whistles attached to wheels. A typical professional display wheel will have a number of drivers and whistle effects, the latter can be up to 25g NEC per whistle. These firework elements are mounted onto a wooden frame of, say, 1 metre diameter. It is unlikely, given the explosive density of these display fireworks, that a mass explosion would occur in a 6(a) or 6(b) test. In order to determine the risks from large whistles on a wheel, the expert from the United Kingdom is carrying out tests on 25g whistles and will present this data in support of a 1.3G classification for professional display wheels containing these whistles. The expert from the United Kingdom proposes that the 1.3G criteria for wheels be amended to permit whistle units up to 25g.

### **6. Rockets**

The United Kingdom has carried out tests on stickless report rockets and found that they pose a mass explosion hazard (UN/SCETDG/23/INF.25). The expert from the United Kingdom reported at the last meeting of the working group that tests on stickless "star" rockets would be completed in 2004. A large

consumer rocket was chosen for Test Series 6(a) study. This rocket head is 76mm in diameter and the rocket contains 200g of pyrotechnic composition of which 100g is contained in the rocket motor (blackpowder). The remaining composition is contained in the rocket head and this contains stars and a bursting charge containing less than 10g of flash composition (=5% flash composition).

A Test Series 6(a) on the rockets was carried out on this stickless "star" rocket. No explosions could be heard, none of the confining material was projected and the witness plate was undamaged. Smoke was seen coming through the confining material at various intervals as the fireworks ignited.

The expert from the United Kingdom proposes that the stickless "star" rocket with less than 200g of pyrotechnic composition and 5% of flash composition cannot be considered to present a mass explosion hazard. Test Series 6(c) results on the stickless "star" rocket will be available for the July Working Group meeting.

## **7. Classification Table**

The expert from the United Kingdom suggests amending the firework classification table as set out in Annex to this working paper.

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## Annex

Type	Includes: / Synonym:	Definition	Calibre /Mass	Classification
shell, spherical or cylindrical	spherical display shell: aerial shell, colour shell, dye shell, multi-break shell, multi-effect shell, nautical shell, parachute shell, smoke shell, star shell; report shell: maroon, salute, sound shell, thunderclap, aerial shell kit	device with or without propellant charge, with delay fuse and bursting charge, pyrotechnic unit(s) or loose pyrotechnic composition and designed to be projected from a mortar	all report shells	1.1G
			colour shell: $\geq 200$ mm or $\geq 2100$ g pyrotechnic composition	1.1G
			colour shell: $< 200$ mm or $< 2100$ g pyrotechnic composition with $> [25]$ % flash composition, as loose powder and/ or report effects	1.1G
			colour shell: $< 200$ mm or $< 2100$ g pyrotechnic composition with $\leq [25]$ % flash composition, as loose powder and/ or report effects	1.3G
			colour shell: $\leq 50$ mm or $\leq 60$ g pyrotechnic composition with $> 2\%$ flash composition as report effects	1.3G
			colour shell: $\leq 50$ mm or $\leq 60$ g pyrotechnic composition with $\leq 2\%$ flash composition as report effects	1.4G
	cylindrical display shell: aerial shell, colour shell, dye shell, multi-break shell, multi-effect shell, nautical shell, parachute shell, smoke shell, star shell; report shell: maroon, salute, sound shell, thunderclap, aerial shell kit	device with or without propellant charge, with delay fuse and bursting charge, pyrotechnic unit(s) or loose pyrotechnic composition and designed to be projected from a mortar	as for spherical shells, longest dimension (height or diameter) determines the calibre	
preloaded mortar, shell in mortar			all report shells	1.1G
			colour shell: $\geq 200$ mm	1.1G
			colour shell: $\geq 50$ mm and $< 200$ mm	1.2G
			colour shell: $> 30$ mm and $< 50$ mm and $< 10$ g of flash composition	1.3G]
			[to be determined	1.4G]

Type	Includes: / Synonym:	Definition	Calibre /Mass	Classification
	shell of shells (spherical) (Reference to percentages for shell of shells are to the gross mass of the fireworks article)	device without propellant charge, with delay fuse and bursting charge, containing report shells and inert materials and designed to be projected from a mortar	> 120 mm	1.1G
combination /batteries	barrage, bombardos, cakes, finale box, flowerbed, hybrid, multiple tubes, shell cakes, banger batteries, flash banger batteries	device without propellant charge, with delay fuse and bursting report shells ≤ [40] mm and/or report units, with ≤ 33% flash composition and ≥ 60% inert materials and designed to be projected from a mortar	≤ 120 mm	1.3G
		device without propellant charge, with delay fuse and bursting charge, containing colour shells and/or pyrotechnic units and designed to be projected from a mortar	> 300 mm	1.1G
Roman Candles	exhibition candle, candle, bombettes	device without propellant charge, with delay fuse and bursting charge, containing colour shells ≤ 70mm and/or pyrotechnic units, with ≤ 25% flash composition and ≤ 60% pyrotechnic composition and designed to be projected from a mortar	≤ 300 mm	1.3G
		assembly including several elements either containing the same type or several types each corresponding to one of the types of fireworks listed in this table, with one or two points of ignition	the most hazardous firework type determines the classification	
		tube containing alternate propellant charges, pyrotechnic units and transmitting fuses		
		≥ 50 mm inner diameter, containing no flash composition		1.2G
		≥ 30 mm and < 50 mm inner diameter, or containing > 25 g of pyrotechnic composition or > 25% flash composition per effect		1.3G
		≤ 30 mm. inner diameter containing ≤ 25 g pyrotechnic composition and ≤ 25% flash composition per effect		1.4G

Type	Includes: / Synonym:	Definition	Calibre /Mass	Classification
Shot tube	single shot Roman candle	tube containing a propellant charge and a pyrotechnic unit, with or without a transmitting fuse	≤ 30 mm, inner diameter containing ≤ 25 g pyrotechnic composition and ≤ 25% flash composition per effect	1.4G
Rocket	avalanche rocket, signal rocket, whistling rocket, bottle rocket, sky rocket, missile type rocket, table rocket	tube containing pyrotechnic composition and/or pyrotechnic units, equipped with stick(s) or other means for stabilization of flight, and designed to be propelled into the air	Flash composition effects only	1.1G
			Flash composition > [25]% of the pyrotechnic composition	1.1G
			Pyrotechnic composition > [20] g per rocket. Total flash composition is < [25]% of the pyrotechnic composition	1.3G
			Pyrotechnic composition ≤ [20] g per rocket and ≤ 0.13 g flash composition per report. Total flash composition is < 10% of the total pyrotechnic composition	1.4G
Rocket without stick(s)	avalanche rocket, signal rocket, whistling rocket, bottle rocket, sky rocket, missile type rocket, table rocket	tube containing pyrotechnic composition and/or pyrotechnic units, not equipped with stick(s) for stabilisation of flight	Flash composition effects only	1.1G
			[Coloured star effect	1.3G]
			[Coloured star effect	1.4G]
			> [25]% flash composition, as loose powder and/ or report effects	1.1G
mine	pot-a-feu, ground mine	tube containing propellant charge and pyrotechnic units and designed to be placed on the ground or to be fixed in the ground. The principal effect is ejection of all the pyrotechnic units in a single burst producing a widely dispersed visual and/or aural effect in the air	≥ 200mm and ≤ [25]% flash composition, as loose powder and/ or report effects	1.1G
			< 200mm and ≤ [25]% flash composition, as loose powder and/ or report effects	1.3G
			≤ [150]g pyrotechnic composition, containing ≤ 5% flash composition as report effects. Each report effect < 2g ; each whistle, if any, ≤ 3 g	1.4G
			> [25]% flash composition, as loose powder and/ or report effects	1.1G
			≥ 200mm and ≤ [25]% flash composition, as loose powder and/ or report effects	1.1G
	bag mine, cylinder mine	cloth or paper bag or cloth or paper cylinder containing propellant charge and pyrotechnic units, designed to be placed in a mortar and to function as a mine	< 200mm and ≤ [25]% flash composition, as loose powder and/ or report effects	1.3G

Type	Includes: / Synonym:	Definition	Calibre /Mass	Classification
fountain	volcanos, gerbs, showers, lances, Bengal fire, flitter sparkle, cylindrical fountains, cone fountains, illuminating torch	non-metallic case containing pressed or consolidated sparks- and flame producing pyrotechnic composition	<p>≥ 1 kg pyrotechnic composition</p> <p>&lt; 1 kg pyrotechnic composition</p>	<p>1.3G</p> <p>1.4G</p>
[sparklers	handheld sparklers, non-handheld sparklers, wire sparklers	rigid wire partially coated (along one end) with slow burning pyrotechnic composition with or without an ignition tip	<p>Pyrotechnic composition for each item</p> <p>≥ 15 g or &gt; 10 items per pack</p> <p>Pyrotechnic composition for each item</p> <p>&lt; 15 g or ≤ 10 items per pack</p>	<p>1.3G</p> <p>1.4G]</p>
[Bengal sticks	Dipped stick	wooden stick partially coated (along one end) with slow-burning pyrotechnic composition and designed to be held in the hand	<p>Pyrotechnic composition for each item</p> <p>≥ 100 g; or &gt; 5 g if flash composition is present or &gt; 10 items per pack</p> <p>Pyrotechnic composition for each item</p> <p>&lt; 100 g; or ≤ 5 g if flash composition is present or ≤ 10 items per pack</p>	<p>1.3 G</p> <p>1.4G]</p>
low hazard fireworks and novelties	table bombs, throw downs, crackling granules, smokes, fog, snakes, glow worn, serpents, snaps, party poppers	device designed to produce very limited visible and/ or audible effect which contains small amounts of pyrotechnic and/ or explosive composition.	<p>Throw downs and snaps may contain up to 1.6 mg of silver fulminate; snaps and party poppers may contain up to 16 mg of potassium chlorate/ red phosphorous mixture; other articles may contain up to 5 g of pyrotechnic composition, but no flash composition</p>	1.4G
spinners	aerial spinners, helicopters, chasers, ground spinners	non-metallic tube or tubes containing gas- or spark-producing pyrotechnic composition, with or without noise producing composition, with or without aerofoils attached	<p>pyrotechnic composition per item &gt; 20 g, containing ≤ 3% flash composition as report effects</p> <p>pyrotechnic composition per item ≤ 20 g, containing ≤ 3% flash composition as report effects, or whistle composition ≤ 5 g</p>	<p>1.3G</p> <p>1.4G</p>
wheels	Catherine wheels, Saxon	assembly including drivers containing pyrotechnic composition and provided with a means of attaching it to a support so that it can rotate	<p>≥ 1 kg total pyrotechnic composition, no report effect; each whistle (if any) ≥ 5 g and ≤ 25 g</p> <p>&lt; 1 kg total pyrotechnic composition, no report effect; each whistle (if any) ≤ 5 g</p>	<p>1.3G</p> <p>1.4G</p>

Type	Includes: / Synonym:	Definition	Calibre /Mass	Classification	
aerial wheels	flying Saxon, UFO's, rising crown	tubes containing propellant charges and sparks-flame- and/ or noise producing pyrotechnic compositions, the tubes being fixed to a supporting ring	<p>&gt; 200 g total pyrotechnic composition or &gt; 60 g pyrotechnic composition per driver, ≤ 3% flash composition as report effects, each whistle (if any) ≤ 5 g</p> <p>≤ 200 g total pyrotechnic composition or ≤ 60 g pyrotechnic composition per driver, ≤ 3% flash composition as report effects, each whistle (if any) ≤ 5 g</p>	1.3G	
Selection pack	display selection box, display selection pack, garden selection box, indoor selection box	A pack of more than one type each corresponding to one of the types of fireworks listed in this table	The most hazardous firework type determines the classification	1.4G]	
[Firecracker	Celebration cracker, celebration roll, string cracker	Assembly of tubes (paper or cardboard) linked by a pyrotechnic fuse, each tube containing report composition intended to produce an aural effect			Each tube may contain not more than 140 mg of report composition.
[Banger	Salute, flash banger, lady cracker	Non-metallic tube containing report composition intended to produce an aural effect			<p>&gt; 40 g flash composition or ? g black powder</p> <p>&gt; 3 g and ≤ 40 g flash composition; or ? g black powder</p> <p>≤ 3 g flash composition or ? g black powder</p>