

TNO report**19EM/0790****The transport classification of fireworks for the
Dutch importer Vuurwerkvisie, collection 2019****Technical Sciences**

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Summary

This report describes the desk study performed for the UN transport classification of fireworks for the Dutch company Vuurwerkvisie. The desk study is based on the results of the UN Test 6(c) conducted with similar fireworks from this importer, the information on chemical composition sheets supplied by the importer and the 'Default fireworks classification table'. This table contains a list of firework classifications which may be used in the absence of UN Test Series 6 data.

The firework products listed in this report are classified as 1.4G, UN 0336. Several compound products, batteries of shot tubes and combinations shall be packed in a UN cardboard box with a specially designed inner packaging to obtain a hazard division 1.4G classification.

Consumer fireworks meeting the Dutch requirements called 'Regeling Aanwijzing Consumenten- en Theatervuurwerk (RACT)' can be classified as hazard division 1.4S (UN0337) if the specially designed firework container (4A/Y490/S/--/NL/Pyropack 2857) is used as outer packaging. For firework combinations with more than 15 grams composition per tube and mine batteries it is necessary to use the Pyropack container with a modified lid.

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1 Introduction

This report describes the hazard classification of firework products from the Dutch importer Vuurwerkvisie, Den Bosch, The Netherlands, to perform a desk study for the UN hazard division classification [1, 2] of their fireworks collection of 2019.

TNO is the competent authority in The Netherlands for the classification of explosives for rail and road transport (RID/ADR).

This hazard classification is based on a desk study. The following documents are considered:

- The classification reports [3];
- The chemical composition sheets supplied by Vuurwerkvisie [4];
- The 'Default firework classification table' [5].

The desk study is performed for the following firework types:

1. Batteries of shot tubes;
2. Combinations;
3. Compounds.

TNO assigned the fireworks to hazard divisions according to the UN Criteria [1, 2]. These criteria are also used by international (IMDG; ICAO) and regional (ADR/RID) transport modes.

In the next chapters provide information on the classification procedure, the 'Default firework classification table', the required packing methods and an overview of the resulting classification of the above mentioned firework types.

2 Class 1, explosives

2.1 General

To determine the transport classification of packaged explosive articles, such as fireworks, the UN Manual prescribes the performance of Test Series 6. Fireworks is assigned to class 1 (Paragraph 2.2.1.1.7.1 of the ADR), Hazard Division 1.1 to 1.4 [2]. The hazard divisions according Paragraph 2.2.1.1.5 of the ADR are defined as follows.

- Division 1.1 Substances and articles which have a mass explosion hazard.
- Division 1.2 Substances and articles which have projection hazard but not a mass explosion hazard.
- Division 1.3 Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. This division comprises substances and articles which give rise to considerable radiant heat or producing minor blast or projection effects.
- Division 1.4 Substances and articles which present no significant hazard.

2.2 The compatibility groups for fireworks

The compatibility group identifies the kind of explosive substances and articles that are deemed to be compatible. Fireworks is assigned to compatibility groups (Paragraph 2.2.1.1.6 of the ADR):

- G Pyrotechnic substance, or article containing a pyrotechnic substance, or article containing both an explosive substance and illuminating, incendiary, tear or smoke-production substance (other than a water activated article or one containing white phosphorus, phosphides, a pyrophoric substance, a flammable liquid or gel, or hypergolic liquids); or
- S Substance or article so packed or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder or prohibit firefighting or other emergency response effects in the immediate vicinity of the package.

3 Default fireworks classification table and RACT

3.1 General

The UN Sub-committee of Experts on the Transport of Dangerous Goods has published a default classification for a large number of firework types. Fireworks shall normally be assigned to hazard divisions 1.1, 1.2, 1.3, and 1.4 on the basis of test data derived from UN-Test Series 6. However, since the range of such tests is very extensive, and the availability of test facilities may be limited, assignment to hazard divisions may also be made on the basis of analogy, without the need for UN-Test Series 6 testing (Paragraph 2.2.1.7.2 of the ADR) but in accordance with the default fireworks classification table. Such assignment shall be made with the agreement of the competent authority.

3.2 Requirements in the Netherlands

Several firework types which are divided into hazard division 1.3 as default classification can be assigned to hazard division 1.4 when special inner packagings, designed to prevent projection of fiery projections, are used. These packagings apply a metal wire netting inner packaging. Details of the packing method for batteries/combination/compounds is given in Appendix A of this report.

Table 1 gives an excerpt from the default table covering rockets, batteries, combinations and shot tubes. The classification shown in Table 1 applies only to firework products packed in cardboard boxes (Packaging type 4G).

3.3 'Regeling Aanwijzing Consumenten en Theater Vuurwerk'

Netherlands consumer fireworks shall comply with the requirements mentioned in the 'Regeling Aanwijzing Consumenten- en Theatervuurwerk, 2010' (RACT) [3]. For some of the firework types the borderlines mentioned in Table 1 are higher than the requirements in the RACT.

Table 1 Excerpt of the 'Default fireworks classification table'.

Type	Specification fireworks	Classification
Rocket	>20 grams pyrotechnic composition and total flash composition $\leq 25\%$.	1.3G
Rocket	≤ 20 grams pyrotechnic composition, black powder bursting charge and ≤ 0.13 grams flash composition per report and <1 gram in total.	1.4G
Battery	< 50 mm inside diameter and containing $\leq 25\%$ flash composition.	1.3G
Battery	≤ 30 mm inside diameter and pyrotechnic unit >25' grams, or >5% and $\leq 25\%$ flash composition.	1.3G
Battery	≤ 30 mm inside diameter, pyrotechnic unit ≤ 25 ' grams total per tube and $\leq 5\%$ flash composition per tube.	1.4G
Combination	≤ 30 mm inside diameter and pyrotechnic unit >25 grams, or >5% and $\leq 25\%$ flash composition.	1.3G
Combination	≤ 30 mm inside diameter, pyrotechnic unit ≤ 25 grams total per tube and $\leq 5\%$ flash composition per tube.	1.4G
Shot tube	≤ 30 mm inside diameter and pyrotechnic unit >25 grams, or >5% and $\leq 25\%$ flash composition.	1.3G
Shot tube	≤ 30 mm inside diameter and pyrotechnic unit ≤ 25 grams and $\leq 5\%$ flash composition per tube.	1.4G

* Does not match with the RACT [3].

3.4 'Autorisatie classificatiecode vuurwerk', Special Provision 645

As of April 1, 2013, TNO is the competent authority mentioned in Special Provision 645 of ADR.

According to this special provision (Paragraphs 3.3.1 and 5.4.1.2.1.(g) of the ADR), when fireworks of UN Nos. 0333, 0334, 0335, 0336 and 0337 are carried, the transport document shall bear the following inscription:

"Classification of fireworks by the competent authority of NL with fireworks reference NL/YYZZZZ" (YY=TNO, ZZZZ=unique serial reference)".

This classification report will be used as the basis of the SP645 approval.

3.5 Time pressure test

From the Paragraph 2.1.3.5.5 (note 2) of the UN Model Regulations a new definition of the flash composition is described as follows:

Flash composition refers to pyrotechnic substances in powder form or as pyrotechnic units as presented in the firework that are used to produce an aural effect or used as a bursting charge, or propellant charge unless the time taken for the pressure rise is demonstrated to be less than 6 ms for 0.5 g of pyrotechnic substance in the HSL Flash Composition Test in Appendix 7 of the Manual of Tests and Criteria.

The HSL flash composition test is used to determine the pressure after ignition of a pyrotechnic composition under confinement in order to determine whether ignition leads to a deflagration with explosive violence at pressures which can be attained with compositions in normal commercial packages.

4 Packing methods; requirements for the Netherlands

4.1 General

To assign Dutch consumer fireworks divided into hazard division 1.3 as default classification to hazard division 1.4, a special inner packaging has been developed. This inner packaging limits the projection of burning fragments and live articles. The inner packaging is a combination of a fibreboard outer box, several hardboard plates, a Styrofoam plate (not for all types) and a wire netting. The use of the correct materials is very important. The positioning of the materials in the boxes depends on the nature of the fireworks. The materials must be placed so that the projection of fragments or complete effects are prevented.

4.2 The firework candidates for using the inner packaging

In The Netherlands the metal wire netting inner packaging is used for firework types divided into hazard 1.3 according the Default fireworks classification table [5].

The following firework types are candidate for using the inner packaging:

- 1 Rocket: a net explosive composition mass in a range from 20 up to 40 grams. And a net explosive composition mass in a range from 0 up to 20 grams containing a flash composition mass between 0.13 and 2 grams.
- 2 Battery or combination: a net explosive composition mass up to 500 grams and more than 5% flash powder per tube and a tube inner diameter of maximally 30 mm.
- 3 Shot tube: a net explosive composition mass up to 40 grams and maximally 2 grams flash powder.
- 4 Compounds: A combination of different batteries of shots tubes or combinations containing a composition mass of maximum 2 kg.
- 5 Assortments: containing one or more of above listed firework types.

4.3 The Pyropack fireworks container

Fireworks fulfilling the requirements of the RACT [7] can be transported in a specially designed steel container [8, 9, 10] as hazard division 1.4S. Figure 1 shows the container. The dimensions are 1200 x 1000 x 1000 mm (length, width, height). This packaging has the marking: 4A/Y490/S/-/NL/Pyropack 2857.



Figure 1 The Pyropack fireworks container.

4.4 The modified Pyropack container

The Pyropack container was originally designed for consumer fireworks allowed before 2010. Since then the regulations have been harmonized as much as possible, with the European standard EN 15947. This harmonization is presented in the RACT [7].

In 2014 additional tests were carried out with a modified Pyropack container with fireworks extending beyond the 2010 limits. Examples are Roman candles with a total net explosive mass of 50 gram, batteries of mines and several combinations. Figure 2 shows the container with a modified lid. Metal strips (width 5 cm) are welded under the lid to prevent the side panels of the container from bending outwards.

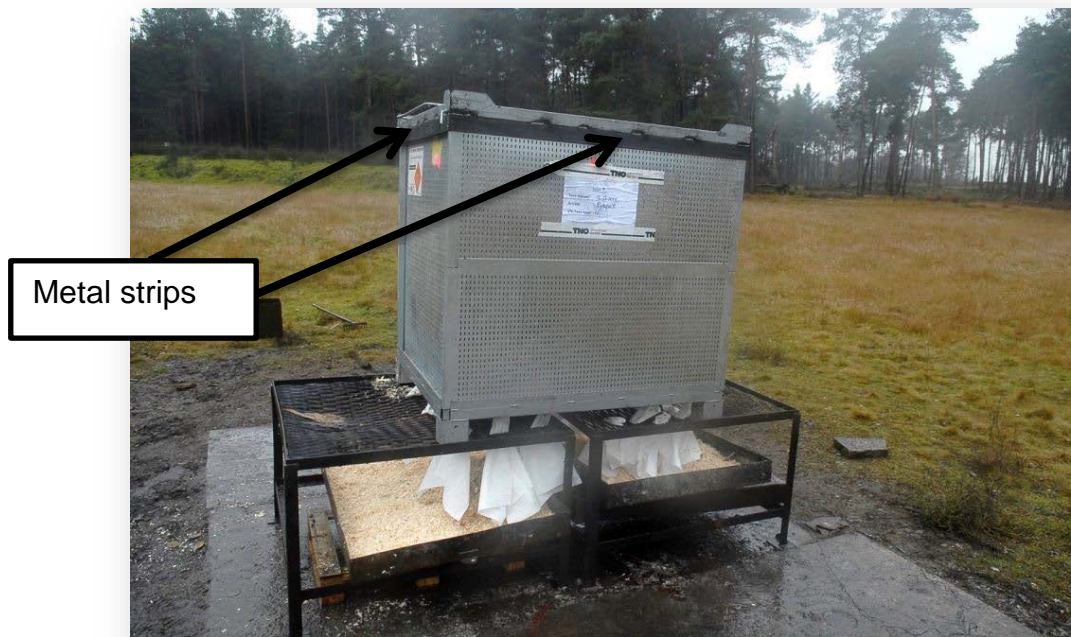


Figure 2 The modified firework container.

5 Hazard classification of fireworks

5.1 General

Based on the results of the UN Test 6(c) performed earlier with similar fireworks, the information on the chemical composition sheets and the 'Default fireworks classification table' [5] TNO concludes that the fireworks listed in Table 2 and 3 can be classified as hazard division 1.4G (UN0336). If transported in the firework container mentioned in section 4.4 and fulfilling the requirements of the RACT [7], fireworks for the Dutch market can be classified as hazard division 1.4S.

All the classifications are valid for international carriage under the terms of ADR [5]. The outer packaging shall comply with the relevant definitions of paragraph 4.1.4.1 of ADR and packaging instruction P135.

5.2 Hazard classification in a cardboard box (4G)

Tables 2 and 3 show the details of the various firework products and the classification.

Table 2 Fireworks classified as hazard division 1.4G.

Article number	Type	Name	N.E.Q. ¹ (g)	Diameter inner tube (mm)	Packaging instruction ²	Classification ³
1001	Battery of shot tubes	Mini Me	20	7.6	n.a. ⁴	1.4G
1004	Battery of shot tubes	Backflip	67.5	20	n.a. ⁴	1.4G
1005	Battery of shot tubes	King Tut	67.5	20	n.a. ⁴	1.4G
1006	Battery of shot tubes	Dancecrew	117	20	n.a. ⁴	1.4G
1008	Battery of shot tubes	Sweet 16	114.4	20	n.a. ⁴	1.4G
1009	Battery of shot tubes	Night Rider	92	25	n.a. ⁴	1.4G
1010	Battery of shot tubes	Warrior	92	25	n.a. ⁴	1.4G
1011	Battery of shot tubes	B-Boy	92	25	n.a. ⁴	1.4G
1012	Battery of shot tubes	Tank	168	25	n.a. ⁴	1.4G
1013	Battery of shot tubes	Dragon	168	25	n.a. ⁴	1.4G
1015	Battery of shot tubes	Deep Pulse	420	25	n.a. ⁴	1.4G
1017	Battery of shot tubes	Rumble	468	25	n.a. ⁴	1.4G
1018	Combination	Future Hulk	500	30	n.a. ⁴	1.4G
1019	Combination	Downforce	500	30	n.a. ⁴	1.4G
1020	Battery of shot tubes	Hardcore Fan	498.6	25	n.a. ⁴	1.4G
1021	Battery of shot tubes	Der Krawall	498.6	25	n.a. ⁴	1.4G
1022	Combination	Zorro	500	30	n.a. ⁴	1.4G
1030	Fountain	Fire Goddess	40	n.a. ⁴	n.a. ⁴	1.4G
1031	Fountain	Crackling Fire	68	n.a. ⁴	n.a. ⁴	1.4G
1032	Fountain	Fire	150	n.a. ⁴	n.a. ⁴	1.4G
1057	Battery of shot tubes	Whistle 500	250	8	n.a. ⁴	1.4G
1058	Battery of shot tubes	Stereo Whistle 900	450	8	n.a. ⁴	1.4G
1102	Battery of shot tubes	Triple Riot	240	20	Version 2.1	1.4G
1106	Combination	Restricted	420	30	n.a. ⁴	1.4G
1139	Combination	Swat Team	500	30	Version 2.1	1.4G
2550	Battery of shot tubes	Alpha	117	20	n.a. ⁴	1.4G
6108	Combination	Engineer	500	30	Version 2.1	1.4G
6303	Battery of shot tubes	Wick@ Sick Fan	498.6	25	n.a. ⁴	1.4G
6412	Battery of shot tubes	Saluted	285	30	Version 2.1	1.4G

¹ Net Explosive Quantity.² See the Appendices.³ The classification is only valid for fireworks packed in an UN cardboard box approved by a competent authority and/or the use of the inner packaging described in this report.⁴ Not applicable.

Table 3 Compounds and assortments classified as hazard division 1.4G.

Item number	Article number	Type	Name	Tube inner diameter (mm)	N.E.Q. ¹ (g)	Packaging instruction ²	Classification ³
1072		Compound	SAYWATT			n.a ⁴	1.4G
	1072a	Battery of shot tubes	Saywatt cake 1	20	400		
	1072b	Battery of shot tubes	Saywatt cake 2	20	400		
1077			Color Experiment			n.a ⁴	1.4G
	1077a	Battery of shot tubes	CE cake 1	25	300		
	1077b	Battery of shot tubes	CE cake 2	25/25	90/54		
	1077c	Battery of shot tubes	CE cake 3	25	300		
	1077d	Battery of shot tubes	CE cake 4	25	180		
	1077e	Battery of shot tubes	CE cake 5	25	300		
1081		Compound	Momentum			Version 2.1	1.4G
	1081a	Battery of shot tubes	Momentum cake 1	25	315		
	1081b	Battery of shot tubes	Momentum cake 2	25	335		
	1081c	Battery of shot tubes	Momentum cake 3	25	375		
	1081d	Battery of shot tubes	Momentum cake 4	25/25	225/90		
1084		Compound	Termoil			n.a ⁴	1.4G
	1084-1	Battery of shot tubes	Termoil cake 1	20	481.6		
	1084-2	Battery of shot tubes	Termoil cake 2	25	432		
	1084-3	Battery of shot tubes	Termoil cake 3	30/30	436.8/9.8		
1129		Compound	Punisher			Version 2.1	1.4G
	1129a	Battery of shot tubes	Punisher cake 1	20	400		
	1129b	Battery of shot tubes	Punisher cake 2	20	400		
1592-1		Compound	Shota of Anarchy 1			Version 2.1	1.4G
	1592-1a	Battery of shot tubes	SA1 cake 1	25	486		
	1592-1b	Battery of shot tubes	SA1 cake 2	25	486		
	1592-1c	Battery of shot tubes	SA1 cake 3	25	486		
	1592-1d	Battery of shot tubes	SA1 cake 4	25	486		
1592-2		Compound	Shota of Anarchy 2			Version 2.1	1.4G
	1592-1a	Battery of shot tubes	SA2 cake 1	25	486		
	1592-1b	Battery of shot tubes	SA2 cake 2	25	486		
	1592-1c	Battery of shot tubes	SA2 cake 3	25	486		
	1592-1d	Battery of shot tubes	SA2 cake 4	25	486		
2715		Compound	Swung			n.a ⁴	1.4G
	2715a	Battery of shot tubes	Swung cake 1	20	132		
	2715b	Battery of shot tubes	Swung cake 2	8	50		
	2715c	Combination	Swung cake 3	8.5	120		
	2715d	Battery of shot tubes	Swung cake 4	20	124		
2716		Compound	Der Streber			n.a ⁴	1.4G
	2716a	Battery of shot tubes	DS cake 1	20	187.5		
	2716b	Battery of shot tubes	DS cake 2	8.5	120		
	2716c	Battery of shot tubes	DS cake 3	20	112.5		
	2716d	Battery of shot tubes	DS cake 4	20	112.5		
	2716e	Battery of shot tubes	DS cake 5	20	195		
2740		Compound	#Magic Moment			n.a ⁴	1.4G
	2740-1	Battery of shot tubes	MM cake 1	25	375		
	2740-2	Battery of shot tubes	MM cake 2	25	375		
	2740-3	Battery of shot tubes	MM cake 3	25	375		

Table 3 Compounds and assortments classified as hazard division 1.4G (continued).

Item number	Article number	Type	Name	Tube inner diameter (mm)	N.E.Q. ¹ (g)	Packaging instruction ²	Classification ³
3437		Compound	Prediction			n.a ⁴	1.4G
	3437-1	Battery of shot tubes	Prediction cake 1	25	432		
	3427-1	Battery of shot tubes	Prediction cake 2	25	471.6		
	3437-3	Combination	Prediction cake 3	30	420		
3438		Compound	Fortress			n.a ⁴	1.4G
	3438-1	Battery of shot tubes	Fortress cake 1	25	471.6		
	3438-2	Battery of shot tubes	Fortress cake 2	25	423		
	3438-3	Battery of shot tubes	Fortress cake 3	25	471.6		
	3438-4	Combination	Fortress cake 4	30	420		
3439			Movement			Version 2.1	1.4G
	3439-1	Battery of shot tubes	Movement cake 1	30	495		
	3439-2	Battery of shot tubes	Movement cake 2	20/25	207.9/287		
	3439-3	Battery of shot tubes	Movement cake 3	30	495		
	3439-4	Battery of shot tubes	Movement cake 4	20/25	175.5/287		
3440		Compound	Zerstörer			Version 2.1	1.4G
	3440-1	Combination	Zerstörer cake 1	30	500		
	3440-2	Combination	Zerstörer cake 2	30	500		
	3440-3	Battery of shot tubes	Zerstörer cake 3	25	496.8		
3446		Assortment	De Feestfabriek			Version 2.1	1.4G
	3446a	Battery of shot tubes	DFF cake 1	25	495		
	3446b	Battery of shot tubes	DFF cake 2	25	495		
6156		Compound	Code Red			n.a ⁴	1.4G
	6156-1	Battery of shot tubes	CR cake 1	25	486		
	6156-2	Battery of shot tubes	CR cake 2	25	495		
	6156-3	Battery of shot tubes	CR cake 3	25	486		
	6156-4	Battery of shot tubes	CR cake 4	25	498		
6157-1		Compound	Pyro1			Version 2.1	1.4G
	6157-1a	Battery of shot tubes	Pyro1 cake 1	25	495		
	6157-1b	Battery of shot tubes	Pyro1 cake 2	25	486		
	6157-1c	Battery of shot tubes	Pyro1 cake 3	25	486		
	6157-1d	Battery of shot tubes	Pyro1 cake 4	25	486		
6157-2		Compound	Pyro1			Version 2.1	1.4G
	6157-2a	Battery of shot tubes	Pyro2 cake 1	25	486		
	6157-2b	Battery of shot tubes	Pyro2 cake 2	25	486		
	6157-2c	Battery of shot tubes	Pyro2 cake 3	25	486		
	6157-2d	Battery of shot tubes	Pyro2 cake 4	30	500		
6158-1		Compound	Papel 1			Version 2.1	1.4G
	6158-1a	Battery of shot tubes	Papel 1 cake 1	25	486		
	6158-1b	Combination	Papel 1 cake 2	30	500		
	6158-1c	Combination	Papel 1 cake 3	30	500		
	6158-1d	Battery of shot tubes	Papel 1 cake 4	25	486		
6158-2		Compound	Papel 2			Version 2.1	1.4G
	6158-2a	Combination	Papel 2 cake 1	30	500		
	6158-2b	Battery of shot tubes	Papel 2 cake 2	25	486		
	6158-2c	Combination	Papel 2 cake 3	30	500		

Table 3 Compounds and assortments classified as hazard division 1.4G (continued).

Item number	Article number	Type	Name	Tube inner diameter (mm)	N.E.Q. ¹ (g)	Packaging instruction ²	Classification ³
6258-1		Compound	Voltbrother 1			Version 2.1	1.4G
	6258-1a	Battery of shot tubes	VB1 cake 1	20	499.2		
	6258-1b	Battery of shot tubes	VB1 cake 2	20	499.2		
	6258-1c	Battery of shot tubes	VB1 cake 3	20	499.2		
6258-2		Compound	Voltbrother 2			Version 2.1	1.4G
	6258-2a	Battery of shot tubes	VB2 cake 1	20	499.2		
	6258-2b	Battery of shot tubes	VB2 cake 2	20	499.2		
	6258-2c	Battery of shot tubes	VB2 cake 3	20	499.2		

¹ Net Explosive Quantity.² See the Appendices.³ The classification is only valid for fireworks packed in an UN cardboard box approved by a competent authority and/or the use of the inner packaging described in this report.⁴ Not applicable.

6 Conclusions

In assignment of the firework importer Vuurwerkvisie a desk study was carried out to classify the firework products of the collection of 2019. The conclusions are as follows.

General

- The classifications are valid for international carriage under the terms of ADR. The outer packaging shall comply with the relevant definitions of paragraph 4.1.4.1 of ADR and packaging instruction P135. The hazard classification as mentioned in this report is only valid if the firework is packed in an UN approved fibreboard box.
- The relevant packaging instructions as given in Appendices A to G shall be followed.
- The hazard classification as mentioned in this report is only valid when the amount and nature of the pyrotechnic compositions in the fireworks are in accordance with the data given in the chemical composition sheets.

Results desk study

- Some of the batteries, combinations and compound products are classified as 1.4G (UN0336) only if packed in the wire netting inner packaging as described in this report.
- The other firework products can be classified as 1.4G (UN0336).
- Consumer fireworks fulfilling the requirements of the RACT can be classified as hazard division 1.4S (UN0337) provided special designed firework container (UN code: 4A/Y490/S/-/NL/Pyropack 2857) is used. When transporting combinations with more than 15 grams composition mass per tube, and mine batteries the modified lid shall be used.

7 References

1. Recommendations on the Transport of Dangerous Goods; Model Regulations, Twentieth revised edition, United Nations, New York and Geneva, 2017 (ST/SG/AC.10.1/Rev.20).
2. Recommendations on the Transport of Dangerous Goods; Manual of Tests and Criteria, Sixth revised edition, United Nations, New York and Geneva, 2015 (ST/SG/AC.10.11/Rev.6).
3. Dirkse, M.W.L., The transport classification of fireworks for the Dutch company Vuurwerkvisie. Collection 2011.
4. Chemical composition sheets of fireworks belonging to the importer Vuurwerkvisie, collection 2019.
5. European Agreement concerning the international carriage of dangerous goods by road (ADR, 2019).
6. Dirkse, M.W.L., The transport classification of consumer fireworks packed in a metal container for Vulcan International Pyrotechnics, TNO-PML 2003-C91.
7. Regeling van de Minister van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer van 13 juli 2010, nr. BJZ2010018765, tot aanwijzing van consumenten- en theatervuurwerk (Regeling aanwijzing consumenten- en theatervuurwerk).
8. Sikkens, P.J., UN type test, steel box for the transport of class 1 item (fireworks), TNO-VERP 033.04954, June 5, 2003.
9. Sikkens, P.J., Packaging approval no. 2857, TNO-VERP 03.04955, June 5, 2003.
10. Authorisation document; NL_TNO-0306-2019.

8 Signature

The Hague, December 2019

TNO

A handwritten signature in blue ink, appearing to read 'Dirkse', enclosed within a thin blue rectangular border.

M.W.L. Dirkse
Classification Expert / Author

A Packaging instruction 2.1: Batteries/combinations/compounds

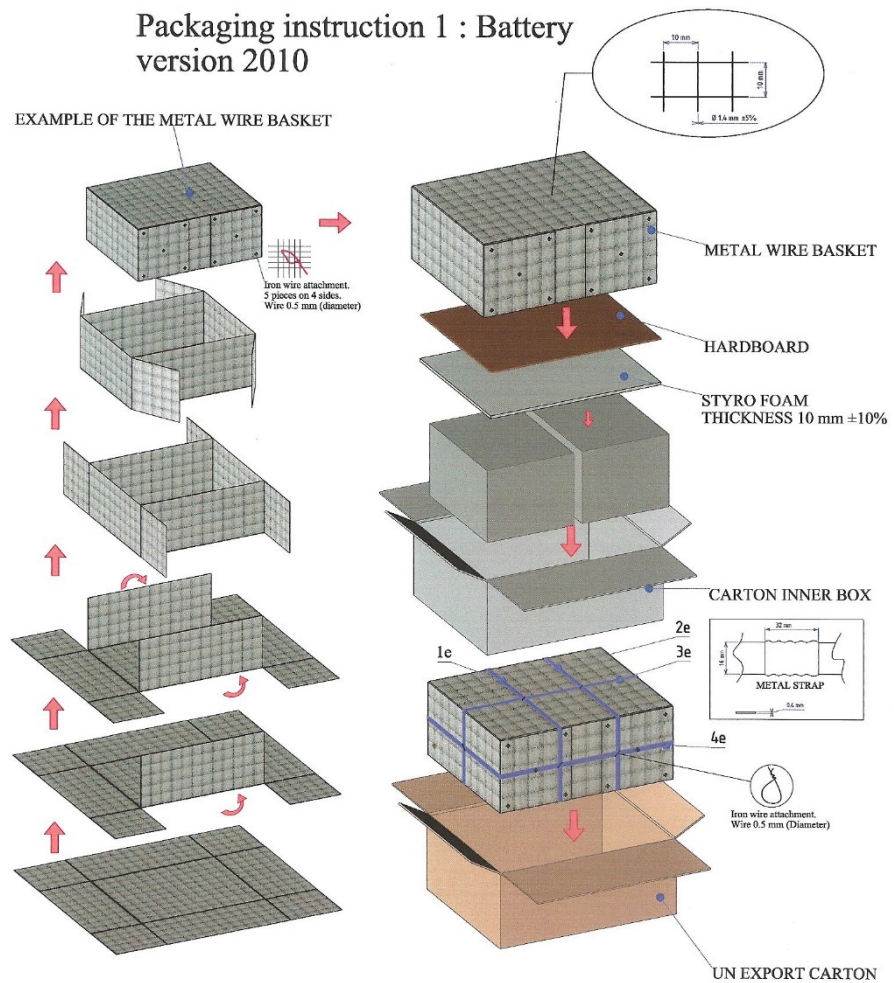


Figure A.1 Drawing of the packaging instruction 2.1.

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