Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

28 June 2023

Sub-Committee of Experts on the Transport of Dangerous Goods

Sixty-second session
Geneva, 3-7 July 2023
Item 2 (a) of the provisional agenda
Explosives and related matters

Testing of igniters to determine appropriate classification

Transmitted by the Council on the Safe Transport of Hazardous Articles (COSTHA) and the Sporting Arms and Ammunition Manufacturers' Institute (SAAMI)

Introduction

1. COSTHA and SAAMI submitted document ST/SG/AC.10/C.3/2023/26 to inform the Sub-Committee of ongoing work in relation to the exit from Class 1 of certain very low hazard explosives, and evaluation of hazardous effects in test 6 (d).

2. The American Pyrotechnic Association (APA) is joining the discussion and effort on the ongoing research being done by SAAMI and COSTHA related to testing products that are currently classed as explosives, to determine if certain low hazard articles can be excluded from Class 1. APA is comprised of members that represent every aspect of the firework industry, including manufacturers, importers, retailers, wholesalers, professional display companies and special effects companies operating around the world. In the USA alone, the fireworks industry has an estimated value of over 3 billion US dollars.

Discussion

3. On 6 June 2023, members of the APA, and representatives of SAAMI and the Explosives Test Center performed testing on three (3) different explosive igniters, which are commonly used in display fireworks and pyrotechnics. A test report is attached in the appendix to this document.

4. The igniters were tested in accordance with the exclusion from Class 1 criteria, from the UN Model Regulations section 2.1.3.6, including:

> 2.1.3.6.4 (a) – No external surface shall have a temperature of more than 65ºC. A momentary spike in temperature up to 200ºC is acceptable.
>
> 2.1.3.6.4 (b) – No rupture or fragmentation of the external casing or movement of the article or detached parts thereof more than one meter in any direction.
>
> 2.1.3.6.4 (c) – No audible report exceeding 136 dB(C) peak at a distance of one meter.
>
> 2.1.3.6.4 (d) – No flash or flame capable of igniting a material such as a sheet of paper in contact with the article.
>
> 2.1.3.6.4 (e) – No production of smoke, flames or dust in such quantities that the visibility in a one cubic meter chamber is reduced more than 50%.

5. The products were also subjected to a modified UN 6(c) external fire test. The unpackaged articles were placed in a steel mesh cage to hold the articles.

6. The results of the testing showed that all of the igniters passed the modified UN 6(c) test with no mass explosion, no damage to the witness panels, and no fiery projections. Depending on the igniter design, the flames were either small bright flashes or indistinguishable from the wood fire. The results of the exclusion testing show that there are variances between specific igniters. Of the three types of igniters that were tested, only one failed the audible report test (2.1.3.6.4(c)), the other two igniters passed all exclusion criteria. There was no ignition of paper in contact with the articles. High speed video footage was obtained.

Conclusion

7. Based upon the results of the testing of the three different igniters, there is evidence that some igniter designs meet the exclusion from class 1 criteria, and therefore would not be considered a dangerous good.

Appendix

Explosives Test Center, LLC

Test Report No. 2023098 on Igniters

EXPLOSIVES TEST CENTER, LLC

5698 Brennan Ave
Colorado Springs CO 80923

505.515.4430
www.explosivestestcenter.com
US DOT Authority CA2015070100

Test Date 6/6/2023
Test Report No. 2023098

American Pyrotechnics Association (APA)
Julie Heckman
4891 Long Beach Rd
Southport, NC 2941

Product Designation

The product designation is ELE219 Igniter, i-shot igniter, Pyrotechnia Mexico PN D3118.

Date and Location

Testing was performed on 6/6/2023 at Pyrotechnique by Grucci/Radford Army Ammunition Plant, VA.

Product Description

The American Pyrotechnics Association (APA) has performed Exclusion from Class 1 testing and the UN 6 (c) External fire test on 3 different, previously approved igniters: ELE219 Igniter, i-Shot Igniter, Pyrotechnia Mexico PN D3118. The ELE219 igniter is produced by Liuyang Wenchi Electric Instruments Co., under product designation "Electric Igniter" (EX2011050771, attached). The i-Shot Igniter is produced by Monetti SRL, under product designation "Electric igniter, type IS-A" (EX2020112129, attached). The Pyrotechnia Mexico PN D3118 is produced by APM Fireworks S.A. DE C.V. under the product designation "D/N: APM200416MX (FFX, FFX mini)" (EX2016050015, attached). These igniters are often used in the fireworks industry as a means to initiate fireworks in display and special effects shows.

Attachments:

1. EX2020112129
2. EX2016050015
3. EX2011050771

Packaging Examined

No packaging was examined for this report.

Testing Conducted and Results

These articles were submitted for evaluation for Exclusion from Class 1 testing. Testing was conducted in accordance with the UN Recommendation on the Transport of Dangerous Goods – Model Regulations, 22nd Revised Edition. The test results are summarized below in Tables 1, 2 and 3, below.

ELE219 Igniter Test Results

Table 1. Results of Exclusion from Class 1 Tests – ELE219 Igniter

Trial	Max Temp (°C)	Displacement (cm)	Audible Report (dBC)	Flash/Flame	Smoke
1	130	1	100.1	No	No
2	53	2.5	90.3	No	No
3	267	2	95.9	No	No

2.1.3.6.4(a) – No External surface shall have a temperature of more than 65°C. A momentary spike in temperature up to 200°C is acceptable. The testing showed a maximum temperature of 267°C in the three trials conducted. The temperature of the article was measured with a FLIR E85 Thermal video camera. This video camera captures at a rate of 30 fps. The ELE219 Igniter did not meet criteria 2.1.3.6.4(a) for exclusion from Class 1.

2.1.3.6.4(b) – No rupture or fragmentation of the external casing or movement of the article or detached parts thereof more than one meter in any direction. The testing showed a maximum displacement of 2.5-cm in the three trials conducted. The ELE219 Igniter met criteria 2.1.3.6.4(b) for exclusion from Class 1.

2.1.3.6.4(c) – No audible report exceeding 135 dB(C) peak at a distance of one meter. The testing showed a maximum audible report of 100.1-dB(C) peak at a distance of one meter using a NTI X2 sound meter with a M4261 microphone in the three trials conducted. The ELE219 Igniter met criteria 2.1.3.6.4(c) for exclusion from Class 1.

2.1.3.6.4(d) – No flash or flame capable of igniting a material such as a sheet of 80 ± 10-g/m^2 paper in contact with the article. The testing showed a brief flash in all three of the trials conducted; however, there was no ignition of the paper in any of the three trials. The ELE219 Igniter met criteria 2.1.3.6.4(d) for exclusion from Class 1.

2.1.3.6.4(e) – No production of smoke, flames or dust in such quantities that the visibility in a one cubic meter chamber … is reduced more than 50%. This test was waived, as the article did not produce significant amounts of smoke. The ELE219 Igniter would meet criteria 2.1.3.6.4(e) for exclusion from Class 1.

UN 6(c) Modified External fire test – This test was conducted in accordance with the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition except for slight modifications: a steel mesh cage was used to hold unpackaged articles. 750 articles were tested in the external fire test. Shrouds and lead wires were left as manufactured. The articles began burning approximately 15 seconds after the start of the fire, with the articles being completely consumed by the fire, there were visible flashes that indicated a reaction had occurred with the last noticeable flash occurring around 1 minute and 4 seconds into the fire. The test resulted in no mass explosion, no damage to the witness panels and no fiery projections beyond 5-m. After testing, it was found that all material had been consumed in the fire. There were no projections which would fall above the 8-J curve in Figure 16.6.1.1 in the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition.

Photos from Testing

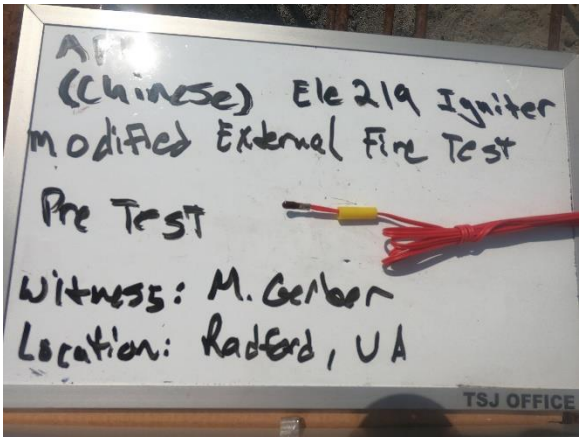

Figure 1. Representative article

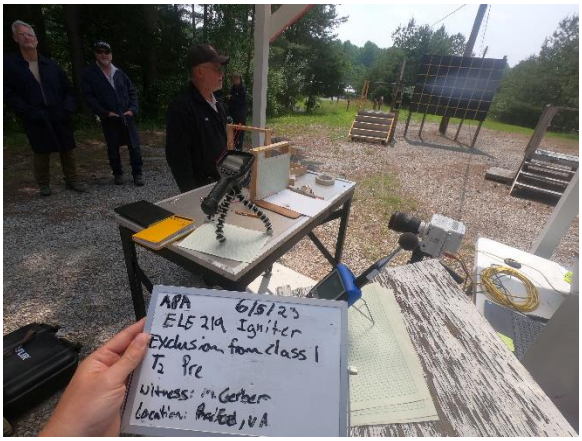

Figure 2. Exclusion from Class 1 test setup

Figure 3. Exclusion From Class 1, pre-test

Figure 4. Exclusion from Class 1, post-test

Figure 5. External Fire Test, pre-test

Figure 6. External Fire Test, post-test

UN 6(c) Modified External fire test – ELE219 Igniter (No leads, No shrouds)

This test was conducted in accordance with the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition except for slight modifications: a steel mesh cage was used to hold unpackaged articles. 4500 articles were tested in the external fire test. The leads of all the igniters were clipped near the head of the igniter, and the shrouds were removed from the igniter head. Without the extra plastic mass, this was determined to be a worst-case scenario that if a mass explosion were to occur, it would be under the scenario that all of the shrouds and leads were removed. The articles began burning approximately 22 seconds after the start of the fire, with the articles being completely consumed by the fire, there was a large visible flash that indicated a reaction had occurred, there was no recorded burn time on this reaction as it was too fast. The test resulted in no mass explosion, no damage to the witness panels and no fiery projections beyond 5-m. After testing, it was found that all material had been consumed in the fire. There were no projections which would fall above the 8-J curve in Figure 16.6.1.1 in the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition.

Figure 18. External Fire Test, pre-test

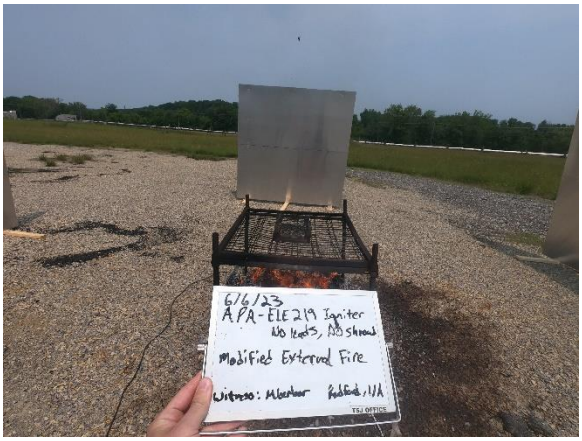

Figure 19. External Fire Test, post-test

i-Shot Igniter Test Results

Table 2. Results of Exclusion from Class 1 Tests – i-Shot Igniter

Trial	Max Temp (°C)	Displacement (cm)	Audible Report (dBC)	Flash/Flame	Smoke
1	125	0	71.2	No	No
2	100	0	80.1	No	No
3	53	0	69.3	No	No

2.1.3.6.4(a) – No External surface shall have a temperature of more than 65°C. A momentary spike in temperature up to 200°C is acceptable. The testing showed a maximum temperature of 125°C in the three trials conducted. This was a momentary spike that fell back below 65°C quickly. The temperature of the article was measured with a FLIR E85 Thermal video camera. This video camera captures at a rate of 30 fps. The i-Shot Igniter met criteria 2.1.3.6.4(a) for exclusion from Class 1.

2.1.3.6.4(b) – No rupture or fragmentation of the external casing or movement of the article or detached parts thereof more than one meter in any direction. The testing showed a maximum displacement of 0-cm the three trials conducted. The i-Shot Igniter met criteria 2.1.3.6.4(b) for exclusion from Class 1.

2.1.3.6.4(c) – No audible report exceeding 135 dB(C) peak at a distance of one meter. The testing showed a maximum audible report of 80.1-dB(C) peak at a distance of one meter using a NTI X2 sound meter with a M4261 microphone in the three trials conducted. The i-Shot Igniter met criteria 2.1.3.6.4(c) for exclusion from Class 1.

2.1.3.6.4(d) – No flash or flame capable of igniting a material such as a sheet of 80 ± 10-g/m^2 paper in contact with the article. The testing showed a brief flash in all three of the trials conducted; however, there was no ignition of the paper in any of the three trials. The i-Shot Igniter met criteria 2.1.3.6.4(d) for exclusion from Class 1.

2.1.3.6.4(e) – No production of smoke, flames or dust in such quantities that the visibility in a one cubic meter chamber … is reduced more than 50%. This test was waived, as the article did not produce significant amounts of smoke. The i-Shot Igniter met criteria 2.1.3.6.4 (e) for exclusion from Class 1.

UN 6(c) Modified External fire test – This test was conducted in accordance with the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition except for slight modifications: a steel mesh cage was used to hold unpackaged articles. 4800 articles were tested in the external fire test. Shrouds and lead wires were left as manufactured. The articles began burning approximately 20 seconds after the start of the fire, with the articles being completely consumed by the fire, there were visible smoke puffs that indicated a reaction had occurred with the last noticeable puff of smoke occurring around 2 minutes and 15 seconds into the fire. The test resulted in no mass explosion, no damage to the witness panels and no fiery projections beyond 5-m. After testing, it was found that all material had been consumed in the fire. There were no projections

which would fall above the 8-J curve in Figure 16.6.1.1 in the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition.

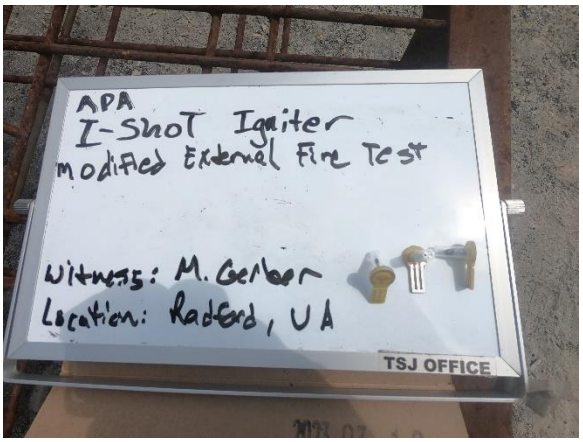

Figure 7. Representative article

Figure 8. Exclusion from Class 1 test setup

Figure 9. External Fire Test, pre-test

Figure 10. External Fire Test, post-test

Pyrotechnia Mexico PN: D3118 Test Results

Table 3. Results of Exclusion from Class 1 Tests – Pyrotechnia Mexico PN: D3118

Trial	Max Temp (°C)	Displacement (cm)	Audible Report (dBC)	Flash/Flame	Smoke
1	63	3.5	101.1	No	No
2	57	2	97.2	No	No
3	108	4	100.7	No	No

2.1.3.6.4(a) – No External surface shall have a temperature of more than 65°C. A momentary spike in temperature up to 200°C is acceptable. The testing showed a maximum temperature of 108°C in the three trials conducted. This was a momentary spike that fell back below 65°C quickly. The temperature of the

article was measured with a FLIR E85 Thermal video camera. This video camera captures at a rate of 30 fps. The Pyrotechnia Mexico PN D3118 met criteria 2.1.3.6.4(a) for exclusion from Class 1.

2.1.3.6.4(b) – No rupture or fragmentation of the external casing or movement of the article or detached parts thereof more than one meter in any direction. The testing showed a maximum displacement of 4-cm in the three trials conducted. The Pyrotechnia Mexico PN D3118 met criteria 2.1.3.6.4(b) for exclusion from Class 1.

2.1.3.6.4(c) – No audible report exceeding 135 dB(C) peak at a distance of one meter. The testing showed a maximum audible report of 101.1-dB(C) peak at a distance of one meter using a NTI X2 sound meter with a M4261 microphone in the three trials conducted. The Pyrotechnia Mexico PN D3118 met criteria 2.1.3.6.4(c) for exclusion from Class 1.

2.1.3.6.4(d) – No flash or flame capable of igniting a material such as a sheet of 80 ± 10-g/m^2 paper in contact with the article. The testing showed a brief flash in all three of the trials conducted; however, there was no ignition of the paper in any of the three trials. The Pyrotechnia Mexico PN D3118 met criteria 2.1.3.6.4(d) for exclusion from Class 1.

2.1.3.6.4(e) – No production of smoke, flames or dust in such quantities that the visibility in a one cubic meter chamber … is reduced more than 50%. This test was waived, as the article did not produce significant amounts of smoke. The Pyrotechnia Mexico PN D3118 would meet criteria 2.1.3.6.4(e) for exclusion from Class 1.

UN 6(c) Modified External fire test – This test was conducted in accordance with the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition except for slight modifications: a steel mesh cage was used to hold unpackaged articles. 495 articles were tested in the external fire test. Shrouds and lead wires were left as manufactured. The articles began burning approximately 1 minutes and 13 seconds after the start of the fire, with the articles being completely consumed by the fire, there were visible flashes that indicated a reaction had occurred with the last noticeable flash occurring around 2 minute and 30 seconds into the fire. The test resulted in no mass explosion, no damage to the witness panels and no fiery projections beyond 5-m. After testing, it was found that all material had been consumed in the fire. There were no projections which would fall above the 8-J curve in Figure 16.6.1.1 in the UN Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria, 7th Revised Edition.

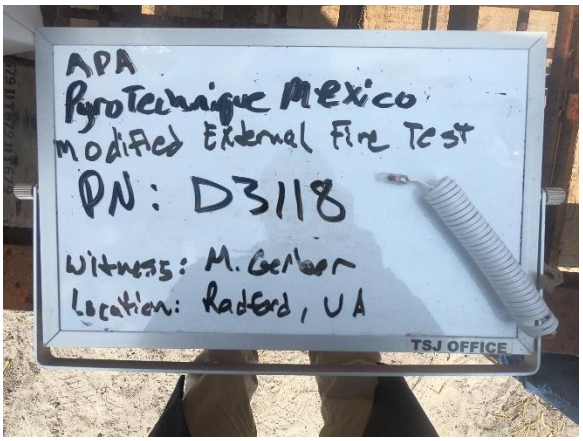

Figure 11. Representative article

Figure 12. Exclusion from Class 1 test setup

Figure 13. Exclusion From Class 1, pre-test

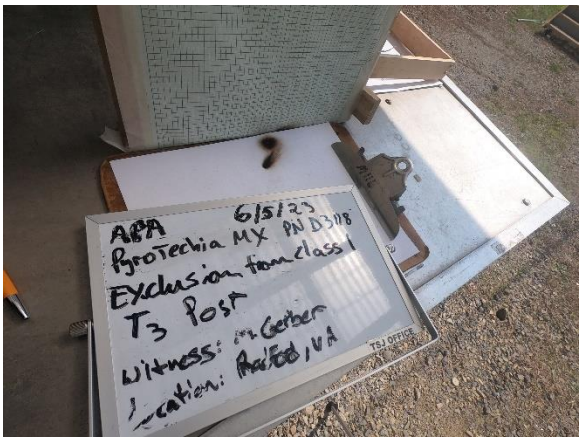

Figure 14. Exclusion from Class 1, post-test

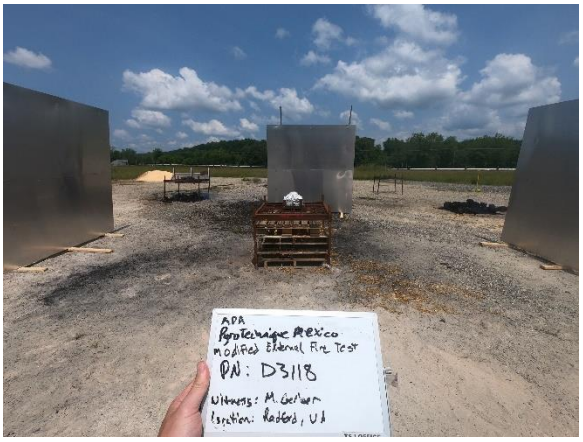

Figure 15. External Fire Test, pre-test

Figure 16. External Fire Test, post-test

Conclusion

The ELE219 Igniter, i-Shot Igniter, Pyrotechnia Mexico PN D3118 have been tested in accordance with 49 CFR §173.56 and UN Model Regulations Section 2.1.3.6.4.1. The ELE219 Igniter did not meet the exclusion

from class 1 criteria because of a temperature reading exceeding 200°C. While the i-Shot Igniter and the Pyrotechnia Mexico PN D3118 did meet the criteria for the exclusion from class 1 testing, this is believed to be due to the limitation of the thermal camera, the reading speed of 30 fps may not be fast enough to capture the quick reaction of the igniters. In all 3 cases, the current interpretation by PHMSA from year 2014 regarding igniters constructed similarly to these 3 articles/cases is that the fragmentation of the igniter head when it activates is enough to fail exclusion from class 1 testing under: *2.1.3.6.4(b) – No rupture or fragmentation of the external casing or movement of the article or detached parts thereof more than one meter in any direction.* The tracking number for this document is 2013080780 and can be found on phmsa.dot.gov.

If you have any questions regarding this report, its contents, or how to proceed, please do not hesitate to call or email Graham Walsh (505.515.4430, gwalsh@explosivestestcenter.com) or Michael Gerber (505.550.1652, mgerber@explosivestestcenter.com).

I hereby certify that this report, and all evaluation, examination, and testing carried out by the Explosives Test Center, LLC in preparation of this report are in full compliance with the applicable requirements of the HMR and this approval.

Examination and Certification by:

Michael Gerber
Engineer
Explosives Test Center, LLC

Attachments:

1. EX2020112129
2. EX2016050015
3. EX2011050771

U.S. Department
of Transportation

East Building, PHH – 32
1200 New Jersey Avenue, Southeast
Washington, D.C. 20590

Pipeline and Hazardous
Materials Safety Administration

The US Department of Transportation
Competent Authority for the United States

CLASSIFICATION OF EXPLOSIVES

Based upon a request by Monetti SRL, Strada Dell'Airone 11 C/D, Orbetello (GR), 58015, Italy, the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). A copy of your application, all supporting documentation and a copy of this approval must be retained and made available to DOT upon request.

An EX approval is non-transferable in any merger, acquisition, sale of assets, or other business transaction. For more information, please visit: [https://www.phmsa.dot.gov/registration/faq-mergers-acquisitions-and-legal-status-changes-pdf]

U.N. PROPER SHIPPING NAME AND NUMBER:
Igniters, UN0454

U.N. CLASSIFICATION CODE: 1.4S

REFERENCE NUMBER:
EX2020112129

PRODUCT DESIGNATION/PART NUMBER:
Electric igniter, type IS-A

NOTES: Outer Packaging – UN 4G fiberboard box containing no more than two thousand (2000) articles for a maximum NEW of 60 grams per package.

DATED: January 07, 2021

William R. Finke

for William Schoonover
Associate Administrator for Hazardous Materials Safety

Tracking No: 2020114294

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U.S. Department
of Transportation

East Building, PHH – 32
1200 New Jersey Avenue, Southeast
Washington, D.C. 20590

Pipeline and Hazardous
Materials Safety Administration

The US Department of Transportation
Competent Authority for the United States

CLASSIFICATION OF EXPLOSIVES

Based upon a request by APM Fireworks S.A. DE C.V., Calle 309 No. 526, D.F. CP, 07420, Mexico the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). A copy of your application, all supporting documentation and a copy of this approval must be retained and made available to DOT upon request.

U.N. PROPER SHIPPING NAME AND NUMBER:
Igniters, UN0454

U.N. CLASSIFICATION CODE: 1.4S

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX2016050015	D/N: APM200416MX (FFX, FFX mini)

NOTES: Each matchhead shall be equipped with a protective plastic shroud.

DATED: 09/23/2016

Harpreet K. Singh

For William Schoonover
Acting Associate Administrator for Hazardous Materials Safety

Tracking No: 2016050056

Page 1 of 1

U.S. Department
of Transportation

East Building, PHH – 32
1200 New Jersey Avenue, Southeast
Washington, D.C. 20590

Pipeline and Hazardous
Materials Safety Administration

The US Department of Transportation
Competent Authority for the United States

CLASSIFICATION OF EXPLOSIVES

Based upon a request by Liuyang Wenchi Electric Ignition Instruments Co., Ltd. , B1001 Developing Bldg., Chong Qing Road, Beihai, Gu 536000, China the following items are classed in accordance with Section 173.56, Title 49, Code of Federal Regulations (49 CFR). A copy of your application, all supporting documentation and a copy of this approval must be retained and made available to DOT upon request.

U.N. PROPER SHIPPING NAME AND NUMBER:
Igniters, UN0454

U.N. CLASSIFICATION CODE: 1.4S

REFERENCE NUMBER	PRODUCT DESIGNATION/PART NUMBER
EX2011050771	Electric Igniter

NOTES: None.

DATED: 08/09/2011

For Dr. Magdy El-Sibaie
Associate Administrator for Hazardous Materials Safety

Tracking No: 2011051286

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