

# Technical – organizational measures for classifying pyrotechnic articles

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**Abstract.** Pyrotechnic articles shall be classified by manufacturers according to their type of use, their purpose and their level of risk, including their noise level, and the notified bodies shall confirm the classification as part of the conformity assessment procedures. In accordance with the relevant national legislation, the national authority must take all appropriate measures to ensure that pyrotechnic articles do not endanger the health and safety of persons. If the national market surveillance authority has sufficient reasons to consider that a pyrotechnic article poses a risk to the health, safety of persons or other aspects of the protection of the public interest, it shall carry out an assessment of the pyrotechnic article concerned. INCD INSEMEX Petrosani is an accredited institution, to carry out such technical expertise according to the legislation in force harmonized with the European regulations, having also adequate modern facilities for fulfilling the requirements of the standards in the field. The paper also highlights the results of the modernization of the methodological and practical infrastructure as well as the technical facilities that underlie the substantiation of the new approach in terms of optimizing and increasing the quality of the process.

## 1 Introduction

INCD INSEMEX Petroșani is an institution authorized to carry technical expertise in accordance with the legislation in force harmonized with European regulations and having appropriate modern facilities to meet the requirements of standards in the field.

The purpose of this paper is to describe how the pyrotechnic article is evaluated (verified) in order to be correctly classified in the category to which it belongs.

In order to be correctly classified in the category to which it belongs, the pyrotechnic articles are subject to an evaluation regarding:

Operation according to the manufacturer's instructions, and if there are no adequate instructions from the supplier on how to operate, the type of object (for example: fireworks, Roman candle, fireworks battery, etc.) will be established in advance and tested on the basis relevant own instructions,

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Determination of the net mass of the pyrotechnic mixture, by separating the pyrotechnic mixture and removing the pyrotechnic composition from each pyrotechnic unit by separating the propellant load, the sound effect load and the effect load and weighing each one. [5, 6]

The legal framework applicable to the field of pyrotechnic articles, regarding the placing on the market and safe use of these products, is regulated both at national level (by Law 319/2006 on safety and health at work with subsequent amendments and completions; Law 126 / 1995 on the regime of explosives and the Technical Implementation Norm, as subsequently amended and supplemented, Decision 1102/2014), as well as at European level (by Directive 2013/29 / EU) laying down the principles to be applied to ensure the legality of explosives, the marketing, handling and use of pyrotechnic articles, as well as the registration and authorization to carry out operations with them, in order to avoid personal injury, material damage or damage to the environment. [3].

## **2 Determination of the content of pyrotechnic articles**

The working procedure for determining the content of pyrotechnic articles involves the following steps:

- Step 1 - To separate the net mass of the pyrotechnic composition from the packaging and ballast, section the packaging in the area where the easiest access to the load is and proceed to empty the contents of the pyrotechnic composition without contaminating it with ballast.

- Step 2 - Bring to zero the balance and the vessel in which the pyrotechnic composition is emptied. Weigh the vessel with the contents of the pyrotechnic composition and record the results.

- Step 3 - Carefully unwrap the test sample. All pyrotechnic units are separated and counted, except for pyrotechnic units which are stars. The number of units containing the sound effect composition is recorded.

- Step 4 - Weigh the pyrotechnic composition not included in the pyrotechnic unit (s). The mass is recorded.

- Step 5 - If necessary, remove the pyrotechnic composition from each pyrotechnic unit by separating the propellant load, the sound effect load and the effect load and weigh each one. The mass of each part is recorded.

- Step 6 - To determine the nature of the cargo mass in the sense that it is or is not a pyrotechnic mixture proceed as follows: after sectioning the pyrotechnic article take a quantity of 1 ÷ 2 g of the material considered to be pyrotechnic, put in a crucible and the behavior in contact with the open flame is observed. If a reaction is found in contact with the flame the material is a pyrotechnic composition if not ballast. Weighing is done with the technical balance, weighing all kinds of loads that have been found to be pyrotechnic composition. [1, 4]

As a security measure, the test should be performed only in specially designed spaces. Exception: For pyrotechnic articles in which it is not possible to make a safe elaboration, the determination of the net mass is done by difference: it is subtracted from the total mass, the packaging and the inert material left after the operation of the pyrotechnic article (consumption of the pyrotechnic composition). [5, 6]

## **3 Checking the operation of pyrotechnic articles**

The pyrotechnic articles are subjected to a functional test according to the manufacturer's instructions. To the extent that there are no adequate instructions from the supplier on how

to operate in advance, the type of object will be established (for example: fireworks, Roman candle, fireworks battery, etc.) and will be tested based on the relevant own instructions. [2]

Initiation: If the initiation mode is pyrotechnic, from open flame, friction, impact, etc., it will be initiated by a suitable means such as pyrotechnic igniter, Bengali match or impact device in order to establish the reliable initiation and subsequently the correct operation according to instructions.

If the initiation mode is electric, the rheophores of the pyrotechnic object will be connected to a suitable electrical source capable of delivering a current and energy sufficient for reliable initiation.

The operation is monitored visually and / or with video recording, observing the appropriate safety distances specific to the type and category of pyrotechnic object. These distances must be at least those specified by the manufacturer. To the extent that they are not specified they shall not be less than: for pyrotechnic entertainment articles of category 1, the safety distance must be at least 1 m, and if necessary the safety distance may be less; for pyrotechnic entertainment articles of category 2 the safety distance must be at least 8 m, and if necessary the safety distance may be less; for pyrotechnic entertainment articles of category 3, the safety distance must be at least 15 m and, if necessary, the safety distance may be less; for pyrotechnic entertainment articles of category 4 the safety distance must be greater than those of category 3. [1, 4]

The spaces in which the test is performed must be appropriate to the type and category of the pyrotechnic article. The temperature and humidity conditions at the time of the test must be within the range specified by the manufacturer. [5, 6]

## 4 Classification of pyrotechnic articles

The classification is carried out in accordance with the test procedure PI-13, based on the requirements of the applicable reference standards, respectively SR EN 15947-3, 4, 5: 2016 and SR EN 16263-4: 2016. [5, 6]

### 4.1 Case study on the classification of pyrotechnic articles

For the classification of pyrotechnic articles with the names HI-TEC / SM9881-FS (fig. 1) and FATANSY STARS / CP 323-FS (fig. 2), the following tests were carried out: Determination of the content of pyrotechnic articles (NEC) according to test procedure PI-97; Verification of the operation of pyrotechnic articles, according to test procedure PI-98; Classification according to test procedure PI-13.



**Fig. 1.** Pyrotechnic articles HI-TEC / SM9881-FS.



**Fig. 2.** Pyrotechnic articles FATANSY STARS / CP 323-FS.

#### 4.1.1 Determination of the net mass of pyrotechnic articles

**Table 1.** Determination of the net mass of pyrotechnic articles

No.	Trade name/ Pyrotechnic article code	Test method / Applicable standard	Net mass of pyrotechnic mixture, (g)
1.	HI-TEC/SM9881-FS	According to GLI-PI-97/ SR EN 15947-4:2016	86,0
2.	FATANSY STARS/CP 323-FS	According to GLI-PI-97/ SR EN 15947-4:2016	10,7

#### 4.1.2 Checking the operation of pyrotechnic articles

**Table 2.** Checking the operation of pyrotechnic articles

No.	Trade name/ Pyrotechnic article code	Test method / Applicable standard	Result
1.	HI-TEC/SM9881-FS	According to GLI-PI-98/ SR EN 15947-5:2016	The pyrotechnic articles after the initiation worked completely.
2.	FATANSY STARS/CP 323-FS	According to GLI-PI-98/ SR EN 15947-5:2016	The pyrotechnic articles after the initiation worked completely.

The pyrotechnic articles were tested on the basis of the PI-98 test procedure, and it was found that all the specimens tested were in working order and, therefore, usable.

### 4.1.3 Classification of pyrotechnic articles

**Table 3.** Classification of pyrotechnic articles

No.	Trade name/ Pyrotechnic article code	Category
1.	HI-TEC/SM9881-FS	F2
2.	FATANSY STARS/CP 323-FS	F2

In accordance with the provisions of Art. 5 (1) of the Technical Norms to Law 126/1995 with subsequent amendments and completions, Art. 7 of Decision no. 1102/2014, SR EN 15947-4, 5: 2016, the pyrotechnic articles are classified according to table no. 4, and their technical characteristics are highlighted in table no. 5. [3]

**Table 4.** Type of pyrotechnic article

No.	Trade name/ Pyrotechnic article code	Type of pyrotechnic article	Category
1.	HI-TEC/ SM9881-FS 0163-F2-2141/ CE 0163	Battery with shot tube	F2
2.	FATANSY STARS/CP 323-FS Without CE marking	Rocket	F2

**Table 5.** Technical characteristic of the pyrotechnic article

No.	Trade name / Type of pyrotechnic article/ Pyrotechnic article code/ No. of registration/ CE marking	Technical characteristics of the expert pyrotechnic article
1.	HI-TEC/ SM9881-FS Battery with shot tube 0163-F2-2141/ CE 0163	<ul style="list-style-type: none"> <li>- Category F2;</li> <li>- NEC identifiable on the label: 84.7 g;</li> <li>- NEC determined by weighing: 86.0 g;</li> <li>- Sound pressure level measured at a distance of 8 m: max. 119.4 dB; [7]</li> <li>- Main / side effect: throwing the pyrotechnic unit with the production of a visual and sound / smoke effect;</li> <li>- Description: Battery consisting of 7 cardboard firing tubes containing propellant charge and pyrotechnic units with explosive charge. The connection between the firing tubes is formed by means of delayed transmission wicks and the initiation of the battery is done from a protected external ignition wick.</li> <li>Housing: non-metallic with outer packaging of paper;</li> <li>- Safety distance: min. 8 m;</li> <li>- Condition of the analyzed sample: no signs of deterioration.</li> </ul>

2.	FATANSY STARS/CP 323-FS Rocket Without CE marking	<ul style="list-style-type: none"> <li>- Category F2;</li> <li>- NEC identifiable on the label: 8.5 g;</li> <li>- NEC determined by weighing: 10.7 g;</li> <li>- Sound pressure level measured at a distance of 8 m: max. 119.4 dB; [7]</li> <li>- Main / side effect: ascent, with visual and sound effects and with the production of visual and sound effects / smoke;</li> <li>- Description: The rocket consists of a tube containing a pyrotechnic composition with an explosive charge, equipped with a rocket engine and a flight stabilization rod. Outer packaging of paper;</li> <li>- Recommended safety distance min. 8 m;</li> <li>- Condition of the analyzed sample: no signs of mechanical damage or moisture.</li> </ul>
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## 5 Conclusions

The applicable legislative framework for the field of pyrotechnic articles, with regard to the safe placing on the market and use of these products, is regulated both at national level (Law 319/2006 on safety and health at work and subsequent amendments, Law 126/1995 on the regime of explosives and the Technical Implementation Norm, as subsequently amended and supplemented, Decision 1102/2014), as well as at European level (Directive 2013/29 / EU) laying down the principles to be applied to ensure the legality of operations with explosives, the marketing, handling and use of pyrotechnic articles, as well as the registration and authorization to carry out operations with them, in order to avoid personal injury, material damage or damage to the environment.

The classification shall be carried out in accordance with the test procedure PI-13, based on the requirements of the applicable reference standards, namely SR EN 15947-3, 4, 5: 2016 and SR EN 16263-4: 2016.

In order to highlight the classification of pyrotechnic articles in categories, 2 types of pyrotechnic articles with the names HI-TEC / SM9881-FS and FATANSY STARS / CP 323-FS were tested, the following tests were performed: Determination of the content of pyrotechnic articles (NEC) according to test procedure PI-97; Verification of the operation of pyrotechnic articles, according to test procedure PI-98; Classification according to test procedure PI-13. According to the provisions of Art. 5 (1) of the Technical Norms to Law 126/1995 with subsequent amendments and completions, Art.7. from Decision no. 1102/2014, SR EN 15947-4, 5: 2016, the tested pyrotechnic articles are classified in category F2.

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