

# Testing maritime distress signals - results and lessons learned

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**Abstract.** Distress signal devices for marine use are vital tools that indicate emergencies in navigable waters and request assistance. They are designed to be easily identifiable and effective for communicating distress to nearby vessels or rescue services. These devices are necessary to guarantee the safety of crew members and passengers on a ship, making it imperative that they function reliably and do not pose risks to users. Consequently, testing these maritime pyrotechnic articles is mandatory due to the stringent safety standards set by international regulatory bodies. This paper presents the results obtained from testing hand flares and buoyant smoke signals at the INSEMEX Petrosani facilities, which were part of a project consortium funded by the EU. Market surveillance authorities from Germany, Norway, and Portugal made up this consortium, and a representative from Belgium provided coordination. The tests yielded several noteworthy findings and insights, underscoring significant concerns regarding personnel safety when using these products in real-life scenarios. The project's outcomes highlighted the necessity for rigorous testing methodologies to ensure the reliability and security of marine pyrotechnic devices. Furthermore, it proposed enhancements and revisions to international standards, which are crucial for mitigating risks and ensuring optimal operational safety for these products in marine applications.

## 1 Introduction

In the context of technological advancement and innovation, the maritime industry consistently prioritises safety as a fundamental principle. Pyrotechnic distress signals serve as vital and reliable instruments for ensuring marine safety among various pieces of life-saving equipment. These signals, notable for their effectiveness in attracting attention during emergencies, are classified as distress pyrotechnics, which include hand flares, rocket parachute flares, and buoyant smoke signals [1].

Marine pyrotechnics serve as distress signals to indicate that individuals on a watercraft are facing serious or imminent danger and require urgent assistance. The testing of marine

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distress pyrotechnic products is crucial to ensure their reliability and effectiveness in emergency situations at sea. [2], [3].

MSAs (market surveillance authorities) encounter challenges regarding the sampling of products from businesses based outside the EU. These businesses often sell directly to European-flagged vessels that dock in harbours in the Far East or South America. As a result, the products seldom enter EU coastal territory, complicating the ability of MSAs to intervene in the supply chain. Furthermore, testing these types of pyrotechnic articles is both noisy and costly, primarily due to the potential hazards associated with non-compliant products [5].

PROSAFE, the Product Safety Forum of Europe, is an essential, non-profit professional organisation comprised of market surveillance officers from across the European Economic Area (EEA). Since its establishment in 1990, PROSAFE's main aim has been to improve product safety for users throughout Europe by promoting better cooperation among market surveillance authorities.

Market Surveillance Projects, such as those coordinated by PROSAFE under initiatives like JAHARP2021-08, play a vital role in ensuring product compliance and safety within the European Union (EU) market. These projects function within the framework of EU harmonised legislation, chiefly the Market Surveillance Regulation (EU) 2019/1020, which seeks to enhance market surveillance and ensure products meet compliance standards [6].

The project commenced in June 2022 and is set to conclude in July 2024. It specifically focuses on consumer fireworks, pyrotechnic marine distress signals, and rescue products. The primary objective is to identify and facilitate the removal of non-compliant products from the market, thereby ensuring the safety of consumers and mariners.

On 1 March 2023, PROSAFE issued an official Call for Tender for the testing of marine distress signals and rescue products within the framework of the JAHARP2021-08 initiative concerning Pyrotechnic Marine Distress Signals and Rescue Products. In response to the tender call, two testing laboratories were selected: BAM Germany, designated for testing rocket parachute flares, and INSEMEX Romania, tasked with testing hand flares, buoyant smoke signals [7], [8].

Similar approaches have been observed in other countries, including the USA. In 2022, a project commissioned by the US Coast Guard (USCG) and conducted by the Radio Technical Commission for Maritime Services (RTCM) examined the effectiveness of Electronic Visual Distress Signals (EVDS) as an alternative to pyrotechnic flares. This research included both laboratory testing and plans for field testing aimed at establishing international standards for the visibility and overall quality of these signals. While specific details about field-checking projects were not extensively covered in the available search snippets for 2022, the RTCM project underscores the ongoing development and evaluation of new distress signal technologies [4].

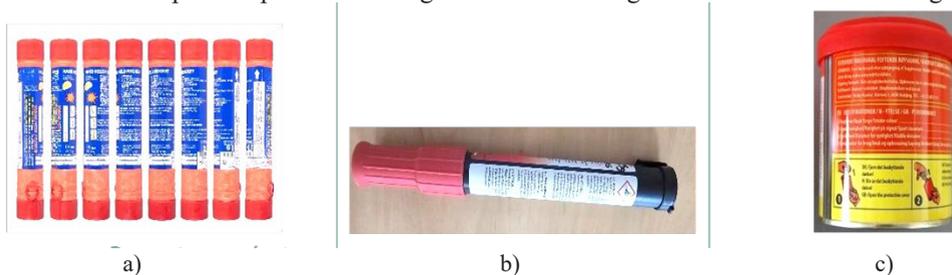
The article discusses the testing activities conducted on marine distress signal items at INSEMEX Romania, along with the results of the tests carried out and the lessons learned from this testing process.

## **2 Testing methodology**

Marine distress signals fall under the scope of the Marine Equipment Directive 2014/90/EU. They are mainly products for professional use sold on a business-to-business market. They are installed on vessels, mainly larger ones, in accordance with international rules issued by the International Maritime Organisation (IMO). The Commission Implementing Regulation (EU) 2024/19753, which lays down rules for the application of Directive 2014/90/EU with regard to design, construction, and performance requirements and testing standards for marine equipment, defines three types of maritime distress signals:

- MED/1.8 - Rocket parachute flares, rockets that are launched by the operator and rise to an altitude of at least 300 m, where a clearly visible red flare is ignited and stays on for at least 45 second while slowly descending;
- MED/1.9 - Hand flares, flares that are ignited and held by the operator while emitting a strong red light for at least 60 seconds;
- MED/1.10 - Buoyant smoke signals, signals that are ignited by the operator and held or left in the water where they will emit clearly visible oranges smoke for at least 3 minutes.

Some examples of products falling under these categories are shown in the Fig. 1.



**Fig. 1.** Marine distress signals - (a) parachute flares, (b) hand flares, (c) buoyant smoke signals

The European Maritime Safety Agency (EMSA) manages a public database for marine equipment, which includes maritime distress signals. Access to this database is available to the public, contingent upon registration. Regarding consumer fireworks, these products must undergo assessment by Notified Bodies, which are responsible for registering the approved products in the database. However, the Joint Action identified several products that were not registered in the database. It is possible that these products obtained approval outside the EU without the involvement of a Notified Body. [9], [10].

Legislation stipulates that a ship flying the flag of an EEA country is considered EEA territory. Consequently, the installation of these articles on an EU-flagged vessel places them within the EU market. "Placing on the market" can occur at any point where the articles are loaded onto the vessel. Typically, the articles will remain untouched in their installed positions until they reach the end of their declared lifetime, at which point they will be replaced with new articles. They are intended for use only in emergencies that jeopardise the safety of the crew and passengers.

These pyrotechnic articles pose two types of risk to the user. Firstly, they can be dangerous if their performance is below expectations; for instance, a rocket that ejects at an insufficient altitude or a flare that extinguishes too quickly can reduce the likelihood of the user being located and rescued compared to a scenario in which all articles function as intended. Secondly, these articles may malfunction in ways that present immediate danger; for example, rockets might fail to launch correctly and instead explode within the life raft, or hand flares could ignite while being held by the user. Furthermore, the articles must not emit burning debris, as the ashes could potentially ignite fuel or other flammable materials that have spread across the sea's surface following the shipwreck [11], [12].

The project, which involved 3 Market Surveillance Authorities (MSAs) from Germany, Norway, and Portugal, aimed to ensure these products met the requirements of the Marine Equipment Directive 2014/90/EU.

The project's investigation into Pyrotechnic Marine Distress Signals involved the identification of 17 products for detailed documentation checks and subsequent laboratory testing. This selection comprised a critical assortment of safety equipment: 6 hand flares, 5 smoke signals, and 6 parachute rockets.

Following the project coordinator's decision, a reduced test program was implemented by excluding several tests from the full program, as illustrated in Fig. 2. The colour coding indicates the following: "red" signifies that the test is included in the program to be applied, while "black" denotes that the test is excluded from the reduced program.

This means that the testing requires 18 specimens of each article, namely specimens 1–15 and specimens 22–24, as can be seen from the tables. The test methods were conducted using the INSEMEX / LMEAP-16 testing procedure, based on IMO.MSC.81(70), IMO MSC.1/Circ.1629, and IMO MSC.48(66) [13], [14].

Test items conditioning sequence	HAND FLARES specimen number									Reference
	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	
Measuring dimensions and mass	A	A	A	A	A	A	A	A		MSC. 81(70)
Temperature cycling test (3.2.2)	D									4.2.1
Low temperature conditioning (3.2.3)		B								4.2.2
High temperature conditioning (3.2.4)			B							4.2.3
Humidity conditioning (3.2.5)				D						4.2.4
1 m immersion for 24h (3.2.7.1)					B					4.3.1
100 mm for 5 min (3.2.7.2)						B				4.3.2
Saltwater spray (3.2.7.3)							B			4.3.3
2 m drop test (3.2.8.1)								B		4.4.1
Safety inspection (3.2.12)	C	C	C	C	C	C	C	C	C	4.5
Operation at ambient temperature	D				D	D	D	D	D	4.2.1, 4.3.1, 4.3.2, 4.3.3 & 4.4.1
Operate at conditioning temperature		D	D	D						4.2.2, 4.2.3 & 4.2.4
Operational test using immersion suit gloves (3.2.8.2)								E		4.4.2
Burning time of flare	E	E	E	E	E	E	E	E		4.7.1
Flare immersion test under water (3.2.8.3)			E							4.7.3
Heptane test (3.2.9)								E		4.7.3
Flare material test colour and luminosity (3.2.10)									F	4.7.2
Life raft drop test (3.2.11)									G	LSA Code Chapter IV/4.1.1.2

Fig. 2. Reduced testing program for hand flares

The project focused on assessing and employing screening methods to enhance the efficiency of market surveillance. It included conducting document inspections, product testing, and verifying online labelling compliance. Figure 3 illustrates the evaluation process for pyrotechnic articles intended for marine use.

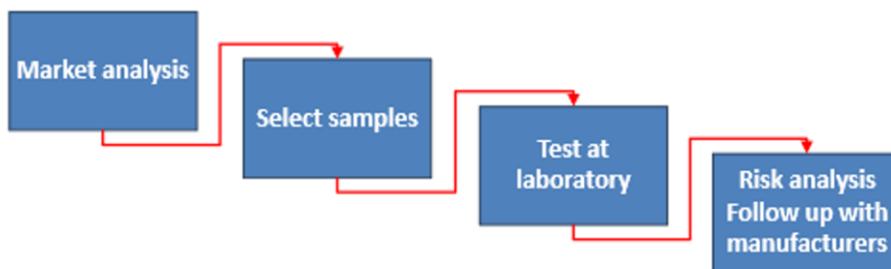


Fig. 3. Market surveillance process

## 2.1 Testing procedures and parameters

In Romania, the National Institute for Research and Development in Mine Safety and Protection to Explosion (INSEMEX) Petrosani conducts testing and research on pyrotechnic articles. The institute's work involves developing a comprehensive testing infrastructure for consumer and maritime pyrotechnic articles, ensuring compliance with the requirements of IMO and EU directives [16], [17]. Their research focuses on safety-critical tests, utilizing equipment such as climate chambers for controlled environment testing. Testing of marine pyrotechnic products involves a comprehensive approach to evaluate their performance under various conditions. Common tests include:

- *Dimensions and Mass Measurement*: This is necessary to ensure compliance with the design specifications.
- *Temperature Cycling Test*: Specimens undergo extreme temperature fluctuations (for example, from  $-30^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$ ) to evaluate their durability and performance under different thermal conditions.
- *Low and High Temperature Conditioning*: Products undergo pre-conditioning at both extremely low and high temperatures prior to functional testing.
- *Immersion Tests*: Products are submerged in water for extended durations (e.g., at a depth of 1 meter for 24 hours) to assess their waterproofing capabilities and ensure they remain functional after being exposed to a marine environment.
- *Operational Stress Testing*: Tests are conducted on hand flares and floating smoke flares to verify their durability and performance under operational stress.
  - operate at ambient temperature
  - operate at conditioning temperature
  - operational test using immersion suit gloves
  - heptane test
  - drop test at 2 m
- *Functional Tests*: This entails the activation of pyrotechnic devices to assess critical parameters, such as:
  - Ignition Delay: The duration from activation to the moment the device ignites.
  - Burn Time: The actual duration of light or smoke emission - minimum of 3 minutes, including smoke color.
- *Safety Inspection*: Conduct visual inspections for any signs of damage, such as shrinking, cracking, or swelling, as well as any changes in mechanical properties or potential hazards.
- *User-Friendliness and Safety Evaluation*: Assessing the ease and safety of operating the devices, considering factors such as recoil, firing mechanism, and the heat generated during use.

The project's investigation into Pyrotechnic Marine Distress Signals involved identifying 17 products for detailed documentation checks and subsequent laboratory testing. This selection included a crucial assortment of safety equipment: 6 hand flares, 5 smoke signals, and 6 parachute rockets. Figure 4 presents a continuous sequence from the 21-day testing program.

Days of the week	Monday	Tuesday	Wednesday	Thursday
No. of Days	1	2	3	4
specimen No. 1.3 / Temp. cycling	B + 65°C 18 pcs.	B - 30°C 18 pcs.	B + 65°C 18 pcs.	B - 30°C 18 pcs.
specimen No. 4.6 / Low temp. cond.	B - 30°C 18 pcs.	B - 30°C 18 pcs.	<b>BT - 30°C 18 pcs.</b>	
specimen No. 7.9 / High temp. cond.		C + 65°C 18 pcs.	C + 65°C 18 pcs.	<b>CT + 65°C 18 pcs.</b>
specimen No. 10.12 / Operate at cond. temp.	<b>DT + 20°C 18 pcs</b>			
specimen No. 13.15 / Immersion 24h/1m	D + 20°C 18 pcs. (1m/24h)	<b>DT + 20°C 18 pcs.</b>		
specimen No. 22.24 / drop + heptane + glove				
<b>Buoyant smoke signals - 5 types</b>				
No. of Days	1	2	3	4
specimen No. 1.3	A+ 65°C 15 pcs.	A 30°C 15 pcs.	A+ 65°C 15 pcs.	A 30°C 15 pcs.
specimen No. 4.6	A+ 65°C 15 pcs.	A 30°C 15 pcs.	A+ 65°C 15 pcs.	A 30°C 15 pcs.
specimen No. 7.9	A+ 65°C 15 pcs.	A 30°C 15 pcs.	A+ 65°C 15 pcs.	A 30°C 15 pcs.
specimen No. 10.12				
specimen No. 13.15		E 1m 24h 15 pcs.	EH IT 20°C / suit gloves/15 pcs.	
specimen No. 22.24	F1 T2 2m drop to st/Heptan test/ 20°C 15 pcs.			
<b>Note :</b>				
B - Temperature Cycling test				
B.1 - Low temperature conditioning				
B.2 - High temperature conditioning				
D - Ambient temperature conditioning				
E - 1 m immersion for 24h				
E.1 - 2 m drop test				
F1 - suit gloves				
F2 - heptan test				
X.T - functioning test				

Fig. 4 Sequence of the 21 days testing program

## 2.2 Testing infrastructure and equipment

Specialized laboratories with controlled environments and calibrated equipment are crucial for accurate testing. INSEMEX Petrosani, through its specialized laboratories, operates a modern facility for testing explosive materials and pyrotechnic articles equipped with state-of-the-art equipment [15]. The following equipment was utilized in the testing of maritime pyrotechnic articles:

- climate chamber ARALAB, Type TESTA CT 1000 ECP 45, measurement range: 45 °C ÷ 180 °C; 10 ÷ 98 % rH., inside dimensions: L x l x H = 105 x 99 x 107 (Fig. 5);
- BINDER climate chamber, type ED 720, measurement range: 5°C ÷ 300°C, inside dimensions: L x l x H = 100 x 60 x 120 (Fig. 6);



Fig. 5 Equipment for the cycling temperature test low/high temperature conditioning



Fig. 6 Equipment for the cycling temperature test high temperature conditioning

- laboratory freezer FROSTER 520, measurement range: - 5°C - 35 °C, inside dimensions: L x l x H = 60 x 42 x 140 (Fig. 7);
- balance PARTNER type PS 4500/C/2, Series No.254113/09, measurement range: max 4500 g and Digital Caliper, KLASS: Serial no. 31C628, measurement range: 300 mm (Fig. 8);



**Fig 7.** Equipment for the cycling temperature    **Fig. 8.** Equipment for measuring dimensions and mass test / low temperature conditioning

- digital chronometer, HANHART, DELTA E 200, Serial No. M231271, measurement range: 9h59 min:59,99 sec. (Fig.9);
- IBC container, inside dimensions: L x l x H = 110 x 90 x 92 (Fig. 10);
- glass vessels for flare immersion test under water, inside dimensions: L x l x H = 35 x 40 x 80 and 100 x 40 x 50 (Fig. 11);



**Fig. 9** Digital chronometer    **Fig. 10** IBC container    **Fig. 11** Glass vessel

- stainless steel vessels for heptane test/functioning test, having in the middle a removable support of 1.2 m height, inside dimensions: L x l x H = 100 x 100 x 20 (Fig. 12);

- small refrigerator for low temperature conditioning test, inside dimensions: L x l x H= 45 x 28 x 37 (Fig. 13);



**Fig. 12.** Stainless steel vessel



**Fig. 13** Equipment for low temperature conditioning test

- small heater for high-temperature conditioning test, inside dimensions: L x l x H = 45 x 28 x 37 (Fig. 14);

- a maritime immersion suit designed for operational tests, featuring gloves made of reinforced neoprene. The suit includes a face seal and flap, 2- or 3-fingered gloves, a front waterproof zipper, ankle cuffs, a neoprene pocket, and retro-reflective tape. (Fig. 15).



**Fig. 14.** Equipment for high temperature test

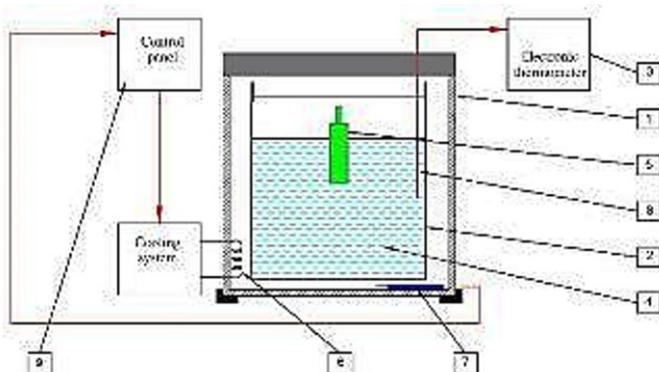


**Fig. 15** Immersion suits

### **2.3 Patenting of the stand for low temperature operation test**

To conduct the low-temperature operating test of the buoyant smoke signals, a stand was created to maintain seawater at a temperature of  $-1^{\circ}\text{C}$ . This setup allows for the activation and testing of marine pyrotechnic articles after they have undergone 10 thermal cycles at temperatures of  $-30^{\circ}\text{C}$  and  $+65^{\circ}\text{C}$ , respectively. Following these cycles, the articles are stored at a temperature of  $-30^{\circ}\text{C}$ .

The stand was patented at OSIM Romania under patent application A/00675/2024. Figure 16 presents the block diagram of the stand designed for conducting the low-temperature operating test.



**Fig. 16** Patented stand for low temperature operation test

**Legend:** **1** – Controlled cooling chamber; **2** – Stainless steel cooling tank; **3** – Electronic thermometer; **4** – Sea water; **5** – Marine pyrotechnic item - Floating smoke generator; **6** – Cooling system; **7** – Cooling chamber temperature control probe; **8** – Type K thermocouple probe; **9** – Control chamber control panel / temperature setting.

### 3 Test results, findings and non-compliances

#### 3.1 Documentation checks

As noted in the previous section, the safety and proper functioning of these articles can be critical for the user, potentially making the difference between life and death. Therefore, the Marine Equipment Directive mandates that manufacturers engage an independent third party, known as a Notified Body (NB), to conduct the conformity assessment of their products. Similarly to the regulations for consumer fireworks, the directive requires manufacturers to implement a production control scheme, which must be overseen by a Notified Body.

The Declaration of Conformity and the type-approval certificate for 30 products have been verified, and it was found that 25 of them did not comply (83%) with one or both documents.



#### 3.2 Laboratory tests

The participating MSAs sampled 17 marine distress signals, which corresponded to almost all the products placed on the market by entities based in the EU. It was notably challenging to obtain samples from manufacturers outside the EU, resulting in only one product from a third country being tested in this project.

The testing results for marine distress signals are profoundly concerning, revealing a widespread and severe lack of compliance. Of the 17 products subjected to laboratory tests, only 2 passed without any remarks. This results in an alarming approximate 88% failure rate among the tested samples, indicating a pervasive and critical issue of non-compliance in this safety-critical product category.

### 3.2.1 Hand flares

All six hand flares tested failed their respective assessments. Additionally, five of the six failed hand flares were found to pose a serious risk to the user (see Fig. 17).

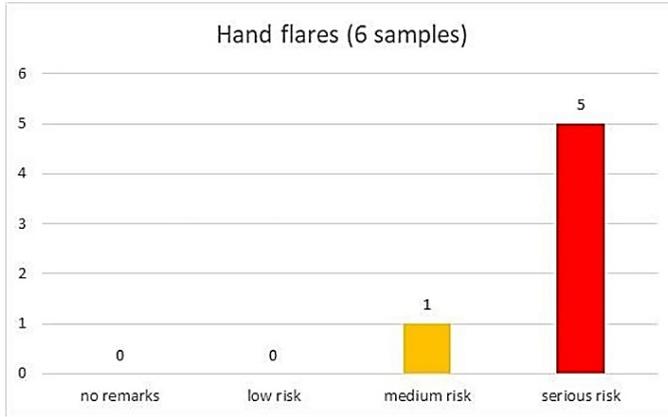


Fig. 17 Test results – hand flares

The test revealed that the articles exhibited several nonconformities. The most significant issues included malfunctioning when ignited, the handle catching fire during operation, excessively short burning times, insufficient time delays before ignition, and failure in the heptane test (Figs. 18 and 19).



Fig. 18 Heptane test - flare ignites the heptane

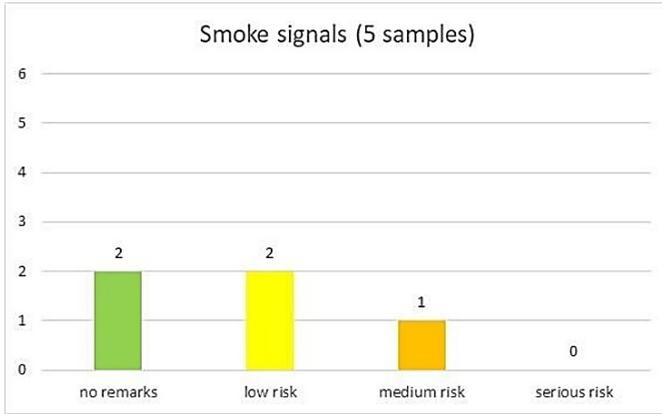


Fig. 19 Remaining part of hand flare after test

### 3.2.2 Buoyant smoke signals

Two of the five smoke signals passed the laboratory test, while the other three failed (Fig. 20). It is important to note that none of the smoke signals were found to pose a serious risk, suggesting that, although some failed, their failure modes were not considered immediately life-threatening.

The most significant nonconformities included overly short burning times, malfunctioning initiation keys, and failure to ignite (Fig. 21).



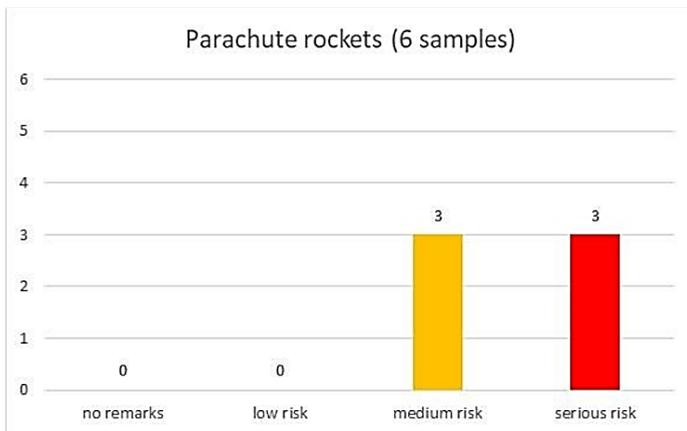
**Fig. 20** Test results – smoke signals



**Fig. 21** Short burning times of tested smoke signal

### 3.2.3 Parachute Rockets

All six parachute rockets tested failed. Notably, three of these six failed rockets were determined to pose a serious risk to the user (Fig. 22).



**Fig. 22** Test results – parachute rockets

The most significant nonconformities included the inability to achieve the required altitude, rocket disintegration upon ignition attempts, unpredictable flight patterns, excessively rapid descent, and burning debris falling to the ground (Fig. 23).

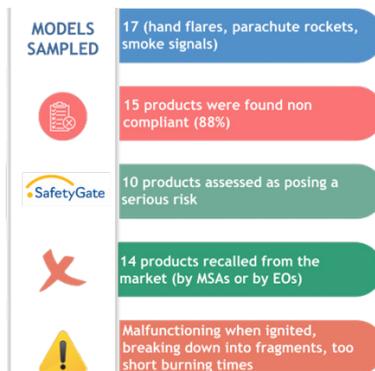


**Fig. 23** Crack opened on bottom part after hitting ground due to strong recoil

Table 1 and Figure 24 present a summary of the test results for pyrotechnic marine distress signals.

**Table 1:** Summary of Pyrotechnic Marine Distress Signals test results

Product category	Total samples tested	Number of samples passed tests (without remarks)	Percentage of samples passed tests	Number of samples failed tests	Percentage of samples failed tests	Number of failed products posing a serious risk
Overall	17	2	12% (approx.)	15	88% (approx.)	8
Hand Flares	6	0	0%	6	100%	5
Smoke Signals	5	2	40%	3	60%	0
Parachute Rockets	6	0	0%	6	100%	3



**Fig. 24** Summary of test results

### 3.3 Main non-compliances and risks/consequences

The identified non-compliances were significant and directly jeopardized the life-saving capabilities of these devices in a marine emergency:

- **Hand flares:** Issues included malfunctioning upon ignition, breaking into fragments, handles igniting during use, excessively short burn times, inadequate delays before ignition, and failing to meet the heptane test (a critical performance standard).

- **Smoke signals:** The observed problems included short burning times, broken initiation keys, and complete failure to ignite.

- **Parachute rockets:** Non-compliances included inadequate burning times, ejection at unacceptably low altitudes, burning debris reaching the ground, excessively high descent rates, ignition malfunctions, or disintegration into fragments.

The test results clearly highlighted the serious consequences of these failures, stating that "Any of these non-compliances can put a crew in a lifeboat in peril or fail to signal a danger." This emphasizes the severe, potentially life-threatening implications of these product failures in real-world emergency situations at sea.

The exceptionally high failure rate in a product category specifically designed for emergency life-saving situations indicates a serious safety gap within the European Single Market. The identified non-compliances, including complete ignition failure, fragmentation, and dangerously short operational times, undermine the essential function of these devices, which is to summon help or signal distress. These widespread and critical failures strongly imply the presence of severe, systemic manufacturing defects, inadequate quality control processes, or insufficient compliance with the stringent safety requirements set forth by the Marine Equipment Directive (2014/90/EU). Consequently, 14 products are anticipated to be recalled from the market, either through enforcement actions by the MSA or as a result of the manufacturers' own initiatives.

In table 2 it is presented the identified non-compliances and associated risks for Pyrotechnic Marine Distress Signals.

**Table 2:** Identified non-compliances and associated risks for Pyrotechnic Marine Distress Signals

Product Type	Specific Non-Compliance Identified	Associated Safety Risk/Consequence
Hand Flares	Malfunctioning when ignited or broke down into fragments	Failure to signal danger, inability to summon help, injury to user/crew from fragments
	Handle caught fire during operation	Injury to user, fire hazard in lifeboat or raft
	Too short burning times	Insufficient time to attract attention, compromised rescue efforts
	Too short time delays before ignition	Premature ignition, injury to user
	Failed the heptane test	Compromised performance in wet or oily conditions, failure to function when needed most
Smoke Signals	Too short burning times	Insufficient duration for effective signaling, compromised rescue efforts
	Broken initiation key or failure to ignite	Complete failure to signal distress, inability to summon help

Product Type	Specific Non-Compliance Identified	Associated Safety Risk/Consequence
Parachute Rockets	Too short burning time	Insufficient time for effective signaling, compromised rescue efforts
	Ejected at too low altitude	Reduced visibility range, burning debris reaching ground level, injury to user/crew
	Burning debris reached ground level	Fire hazard to vessel or lifeboat, injury to user/crew
	Descent rate too high	Reduced visibility time, compromised effectiveness as a signal
	Malfunctioning when ignited or broke down into fragments	Failure to signal danger, inability to summon help, injury to user/crew from fragments

## 4 Lessons learned

The JAHARP2021-08 project has highlighted various ongoing challenges that Market Surveillance Authorities (MSAs) regularly encounter in their efforts to maintain product safety within the Single Market.

A significant and immediate concern is the consistently poor quality of products available on the market. This situation requires proactive measures from manufacturers to implement "real and significant improvements" in quality and compliance. Additionally, it demands close and unwavering follow-up by MSAs to ensure that these improvements are made and sustained.

By analyzing the test results, including the type, nature, and causes of failures, we identified and learned several lessons. These lessons should serve as the foundation for future analysis, which will lead to changes in how these items are tested:

- The conditioning of samples appears to significantly influence their performance;
- Most type approvals are based on testing conducted at the manufacturers' facilities, with a Notified Body present to witness the process;
- Type approval certificates were extended for an excessively long duration. Test reports often date back over 20 years;
- The process of importing into the EU involves complex customs procedures. Customs duties are not applicable to products imported for testing purposes;
- There are no laboratories in Europe accredited to test marine distress signaling equipment. The formal solution was to utilize test laboratories that specialize in fireworks and to observe the testing activities;
- The batch control schemes are ineffective. The failure rates observed in the project should have been identified by the manufacturers' production control schemes;
- The quality of products available in the market significantly fell short of the expectations for certified items. It is essential to examine the adequacy of the certification criteria as well as the implementation of type tests and quality inspections;
- It was unclear whether the preconditioning was performed when the manufacturers tested the articles. For instance, the cold/hot preconditioning took 20 days, making it difficult to believe that a Notified Body would oversee the entire process. Based on what the Joint Action observed, all testing was conducted on randomly selected specimens that were tested without any prior conditioning. At the same time, possibilities for improving the activity were also identified;

- Type approval based on tests conducted by the manufacturer and monitored by Notified Bodies should not be accepted. Instead, the manufacturer should utilize an independent, accredited testing laboratory;
- Test results that are more than 15 years old should no longer be accepted for type approval;
- The manufacturers' obligation to provide samples for market surveillance, as outlined in Article 25(4) of Directive 2014/90/EU, needs to be more specific about the location for provision;
- The improvement of IMO MSC.81(70) should include a description of the permitted or required weather conditions during testing, a clearer outline of the conditioning and handling of articles between the end of conditioning and the testing phase, and a more detailed description of the test method and rig used for the heptane test.

## 5 Conclusions

The JAHARP2021-08 Market Surveillance Project has provided important insights into the compliance status of marine distress signals within the European Single Market. Nearly 90% of the tested products, which are essential for safety at sea, failed to meet standards, with many posing serious, potentially life-threatening risks. Additionally, while consumer fireworks exhibited significant non-compliance and widespread documentation errors, the severity of failures in marine safety equipment highlights a critical safety gap that requires immediate attention.

The test results highlighted ongoing operational challenges for Market Surveillance Authorities. These challenges include the widespread presence of low-quality products in the market, the inherent difficulties in intercepting non-EU-sourced goods that circumvent traditional entry points, and the growing complexities introduced by the rise of online sales channels. Collectively, these issues impede the effectiveness of market surveillance and require continuous, robust enforcement. Additionally, there is an urgent need for harmonized market surveillance methodologies across all Member States to ensure a more comprehensive, consistent, and statistically representative understanding of market compliance.

The MSAs involved in Joint Action gained several valuable lessons, which they are now sharing with their European counterparts through the outcomes of testing reports.

MSAs encounter similar challenges with marine pyrotechnics as they do with consumer fireworks: testing is costly, there are limited testing facilities available in Europe, and transportation is both expensive and complex. A key difference, however, is that the market for marine pyrotechnics does not have a seasonal aspect. Additionally, the models are not updated as frequently as those for consumer fireworks, which facilitates the MSAs' ability to review products and address instances of non-compliance.

The participating MSAs encountered challenges in sampling marine distress signals produced outside the EU. As a result, they were unable to verify the compliance of certain products that are also utilized on EU-flagged vessels.

More testing of joint actions is necessary in this field to ensure that the safety of pyrotechnic articles is monitored and that economic operators are informed and able to address any problems encountered.

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