

# **SUPPORTING DOCUMENT FOR THE STAKEHOLDER CONSULTATION QUESTIONNAIRE**

**EXEMPTION ENTRY NO 45, ANNEX III OF ROHS  
DIRECTIVE 2011/65/EU**

**2025-29-07**



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# EXECUTIVE SUMMARY

Orica strongly believes that entry no 45 in annex III of the RoHS Directive should NOT be extended past its current expiration date of 20 April 2026. Manufacturers of electric and electronic detonators, and their components, have had over 14 years in totality to find replacements for the lead and hexavalent chromium substances specified in the exemption. One extension to the deadline was granted previously for the maximum period of five years. A second extension is not warranted.

Orica has invested in developing lead-free electronic detonators under the brand names i-kon™ III Neo, eDev™ II Neo and uni tronic™ 600 Neo for a wide range of civil applications - in mining, quarrying and construction markets. These products completed CE certification in February 2025 for use in the EU market and commercial release is planned before the current expiration date of the exemption. Orica has also developed a detonator range, Exeldet Neo that can be used for assembly of electric detonators and was released to the market in September 2023. All these products utilise proven technology for safe and reliable initiation of the detonator and the performance is consistent with detonators containing lead. All of Orica's lead-free products have been tested and certified for use in the EU market, with final manufacturing in our facility at Gyttorp, Sweden.

A range of alternative technologies and substances to lead and hexavalent chromium have long been available on the market, demonstrating that lead-free solutions are well-established. Non-primary explosive detonator (NPED) technology has been used in civil applications for over 30 years, while lead azide alternatives diazodinitrophenol and nickel hydrazine nitrate are also available.

Replacing lead in the civil explosives industry offers significant benefits for safety, human health, and the environment. For workers in production, it reduces the risk of exposure to toxic substances. Replacing lead minimizes the risk of contaminating air, soil, and water, and in this way protects biodiversity and safeguards EU agriculture, supporting the production of safe, healthy food. Replacing lead also decreases the amount of hazardous waste that is generated. Each of these align with long-held EU policy priorities, including Europe's green transition.

Orica Sweden has demonstrated that substitution of lead in the manufacture of civil explosives in the EU is technically and commercially feasible. The achievement serves as a tangible demonstration of the commitment to corporate social responsibility and of the investment in innovation that is required to secure the protection of human health and the environment. The requirement for lead substitutes has created jobs in sectors focused on sustainable materials and technologies, benefiting local economies in the EU.

The use of lead substances in manufacturing is increasingly regulated worldwide due to its environmental and human health risks. Orica Sweden AB has reduced the amount of lead used by 1.5 tonnes per year at the initiating systems manufacturing plant in Gyttorp, Sweden. For every 10 000 lead-free detonators manufactured at the plant, approximately 1 kg of lead will no longer be introduced into the life cycle of the product. By removing lead from the products, there are no lead oxides released into the environment during blasting by the end-users. This result, and the protection it delivers for human health and for the environment is precisely what Directive 2011/65/EU was intended to achieve and for which adequate time has been provided for industry to action given the availability of substitutes.

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# 1. INTRODUCTION

This supporting document is prepared for the stakeholder consultation questionnaire published as part of the technical and scientific assessment study of exemption entry no 45, Annex III of RoHS Directive 2011/65/EU.

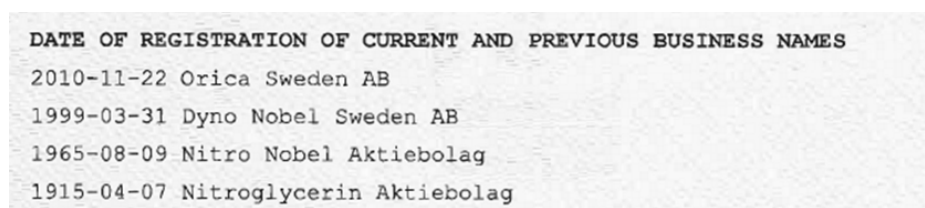
## 1.1 PURPOSE OF THE DOCUMENT

The purpose of this supporting document is to provide additional information to supplement the consultation questionnaire. The view and position of Orica is that the current exemption, entry no 45 in annex III of RoHS Directive should NOT be extended past its current expiration date of 20 April 2026. Orica recommends the shortest transition period that is possible. Orica has utilised the transition period to identify and put into use alternatives for the lead and hexavalent chromium substances used in electric- and electronic detonators in the pursuit of achieving compliance with the exemption window.

In this document, Orica presents the different technologies and products it has invested in, along with references to official approvals for placing these products in the EU market. The document also provides examples of other available technologies and substances that can serve as alternatives to lead and hexavalent chromium substances specified in the current exemption.

## 1.2 STAKEHOLDERS

Orica Sweden AB is a part of Orica Limited, a global manufacturer and distributor of explosives for civil use with over 150 years of experience in innovation, research and technology. In the manufacturing plant for initiating systems located in Gyttrorp, Sweden, electronic detonators and components are manufactured for the EU market. When reference is made to development and research performed in the past, other business names may also appear in this document. The previous business names for Orica Sweden AB are provided in Figure 1 below.



| DATE OF REGISTRATION OF CURRENT AND PREVIOUS BUSINESS NAMES |                          |
|-------------------------------------------------------------|--------------------------|
| 2010-11-22                                                  | Orica Sweden AB          |
| 1999-03-31                                                  | Dyno Nobel Sweden AB     |
| 1965-08-09                                                  | Nitro Nobel Aktiebolag   |
| 1915-04-07                                                  | Nitroglycerin Aktiebolag |

Figure 1: Orica Sweden AB's previous business names from the certificate of registration issued by the Swedish companies registration office.

Orica has been researching the design and performance of electronic blasting systems since the 1980s. Orica Canada Inc have manufactured electronic detonators since 2006 and have played an important role developing and testing the lead-free Orica detonators referred to in this document.

## 1.3 TIMELINE

RoHS II directive 2011/65/EU was published in the official journal of the European Union in 1<sup>st</sup> of July 2011 and entered into force 20 days later. From 3 January 2013 RoHS II directive was in full effect. The scope of the directive was extended to include new products groups, covered under the new entry 11 in annex I. This entry was a catch-all category targeting *other electric and electronic detonators (EEE) not covered by any of the categories above*. Electric and electronic detonators and their components meeting the definition of EEE have been in scope of the directive since the

introduction of the new entry. A transition period was given for all EEE that was impacted by the extended scope in entry 11, to be continued to be made available on the market until 22 July 2019.

Manufacturers of EEE have been or should have been aware of the requirements under the RoHS II directive since 2011, providing them with an initial 8-year window to find suitable replacements for the restricted substances.

In January 2018, the company Austin Detonator s.r.o. submitted an exemption request for an extension of the 22 July 2019 deadline. Following a 1.5 year period of analysis and consideration, the request was accepted, providing an additional 5-year extension for use of six specific substances until 20 April 2026.

From the initial directive, the transition period, and the most recent exemption, manufacturers have been given 14 years in totality to find suitable replacements for the specific lead and chromate substances.

# 2. BACKGROUND

## 2.1 SCOPE OF THE EXEMPTION

The scope of the current RoHS exemption<sup>1</sup> is outlined in Figure 2 and covers civil (professional) use of electric- and electronic initiators for end use in the mining, quarrying and construction markets.

|     |                                                                                                                                                                                                                                                                                                          |                                                                  |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| '45 | Lead diazide, lead styphnate, lead dipicramate, orange lead (lead tetroxide), lead dioxide in electric and electronic initiators of explosives for civil (professional) use and barium chromate in long time pyrotechnic delay charges of electric initiators of explosives for civil (professional) use | Applies to category 11 and expires on 20 April 2026 <sup>2</sup> |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|

Figure 2: Entry 45 in Annex III to Directive 2011/65/EU.

“Electric- and electronic initiators” includes the finished assembled electric- and electronic detonators with the wire, see Figure 3.

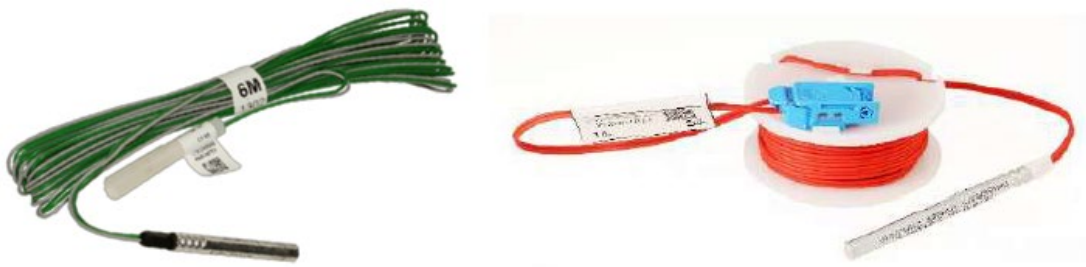


Figure 3: Examples of finished assembled electric detonator (to the left) and electronic detonator (to the right).

The term would also include individual components like an electric igniter, electric fusehead or hybrid components based on those, see Figure 4.



Figure 4: Example of components, electric igniter consisting of a fusehead and wire (to the left) and fuseheads (to the right).

All products and components described above would meet the definition of electrical and electronic equipment (EEE)<sup>2</sup> as defined in the RoHS directive.

There are six specific lead and hexavalent chromium substances mentioned in the current exemption and the following sections will provide a brief overview on the background and uses of these substances.

## 2.2 LEAD AZIDE

Lead azide or lead diazide is one of the most widely produced primary explosives. Primary explosives represent extremely sensitive materials that easily explode with the application of shock, spark, fire, friction, impact and heat. They are used in small quantities in primers, detonators and

percussion caps. Lead azide has been in use since the early 1900s<sup>3</sup> due to its high initiation efficiency and extremely short pre-detonation zone under normal conditions.

The high initiating efficiency, high density, reasonably good stability, ability to withstand high pressures without becoming dead pressed, and long-term experience of lead azide are the main reasons for its extensive application as a primary charge for detonating secondary explosives in flash, stab, non-electric, electric, electronic and other types of detonators.

Despite all its benefits, the toxicity of lead azide caused by the presence of lead, has resulted in research and development work for finding suitable non-toxic primary explosives that could completely replace the substance for both military- and civil use applications.

## 2.3 LEAD STYPHNATE

Lead styphnate is a primary explosive with a high sensitivity to flame but with a low initiation efficiency. It is also very sensitive to initiation from electrostatic discharges. The low temperature sensitivity of lead styphnate is used to improve the reliability of primary charge mixtures in detonators and in fusehead compositions, to lower energy ignition events.

The combination of the high flammability of lead styphnate and the high initiating efficiency of lead azide has been the reason for using a mixture of these two substances in blasting caps since 1920<sup>4</sup>. Lead styphnate is also the main component of many pyrotechnic mixtures for primers often in combination with other substances. Despite its functional properties for primer applications and plenty of documented research about the substance, the presence of lead is causing its replacement by non-toxic alternatives.

## 2.4 LEAD DIPICRAMATE

Lead dipicramate is used as a sensitizer in fuseheads compositions. It is used as an alternative to lead styphnate as it is less sensitive to electric sparks. Salts of picric acid were for some time used as primary explosives in initiating compositions however the low sensitivity prevented the salts from fulfilling the function of a primary explosive and the substances were better suited for igniferous compositions, or as components in mixtures for fuseheads<sup>5</sup>.

## 2.5 LEAD TETROXIDE, LEAD DIOXIDE AND BARIUM CHROMATE

The three substances lead tetroxide, lead dioxide and barium chromate can all be used as a source of oxygen in gasless pyrotechnic mixtures, meaning no gas is formed during combustion. When used in confined spaces like a delay element of an electric- or non-electric detonator, gasless compositions are preferred. The main components of a gasless pyrotechnic mixture are oxidizers, fuels and binders. The mixtures are capable of a highly exothermic oxidation-reduction reaction.

## 3. SUBSTITUTES FOR LEAD AND HEXAVALENT CHROMIUM

There is a variety of different technologies and substances available on the market that can be used as alternatives to the six lead and hexavalent chromium substances specified in the current exemption. This chapter will provide an overview of the technologies developed or used by Orica as well as examples from other companies and industries.

### 3.1 SUBSTITUTES FOR THE PRIMARY CHARGE USED IN DETONATORS

Lead azide and lead styphnate can be used as a primary charge in electric- and electronic detonators. Both substances can be replaced by a lead-free primary explosive or by a different type of technology based on non-primary explosives.

Figure 5 gives some examples of primary explosive substances that can be used as substitutes.

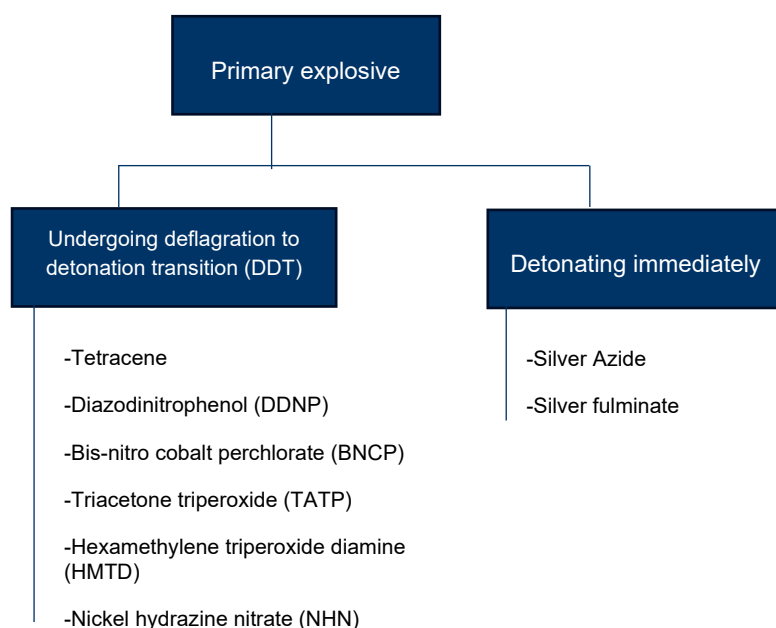


Figure 5: Two subdivisions of primary explosives substitutes with some common examples.

Diazodinitrophenol (DDNP) is widely used in commercial and military detonators as an efficient primary explosive. DDNP has been known for more than 160 years<sup>6</sup> and found its application as an initiating explosive in both military and commercial detonators<sup>7</sup>. It is also used in stab and percussion primer mixtures. Due to the absence of heavy metals in the molecule it is widely used in non-toxic types of primers. In China, it is widely used in commercial detonators for civil use<sup>8</sup>.

Nickel hydrazine nitrate (NHN) was first reported more than 60 years ago<sup>9</sup> and has been proposed as a primary explosive to replace lead azide in commercial detonators<sup>10</sup>. Others recommended NHN as a complete replacement for lead styphnate and a partial replacement of lead azide in detonators<sup>11</sup>.

### 3.1.1 DDT DEVICES

Deflagration to detonation transition (DDT) devices, have been under development since the 1950's, as replacements for primary explosives. A DDT device will generate an initiating shock to the base charge of a detonator when ignited by the hot particles from a fusehead, delay element or shock tube. DDT devices are also referred to as initiation elements, i-elements.

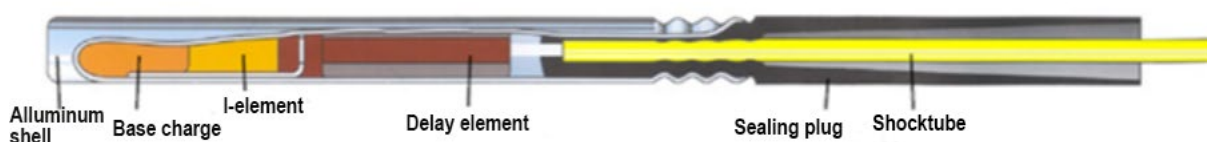
The general design of a DDT device consists of a confinement element into which layers of a fast pyrotechnic, secondary explosives have been pressed. The secondary explosive layers are designed to act as a laminar/convective burning charge, and a transition charge.

### 3.1.2 NPED DETONATOR

In 1993 Dyno Nobel Sweden AB introduced a non-primary explosive detonator (NPED) to the market as an electric- and non-electric detonator, which contained a DDT device that replaced the lead azide primary charge. This was the first commercial primary free explosive detonator for the civilian rock blasting market. The basic NPED concept was developed by Safety Technology Research Institute (SEPRI) in Wuhan, Peoples Republic of China<sup>12</sup> and the concept was procured by Nitro Nobel AB in the middle of 1984 and an evaluation and development program was initiated.

By replacing lead azide for a DDT device in detonators, improvements in safety, lead reduction and higher detonator impact resistance could be made. Lead azide, a simple molecular explosive, will reliably initiate PETN or tetryl with as little as 3 mm or less of run up distance to full detonation pressure, whereas a DDT device is a careful assembly of pyrotechnic mixtures and secondary explosive mixtures of specific particle sizes, pressed to confinement elements to tight tolerances, which in total have run up distances of over 10 mm.

Figure 6 shows the general design of an NPED detonator. The primary explosive has been replaced by an initiation element, I-element. In the initiation element the firing impulse from the delay element is rapidly transformed from deflagration to detonation which then initiates the base charge.



*Figure 6: NPED schematic design showing the inside of the aluminium shell.*

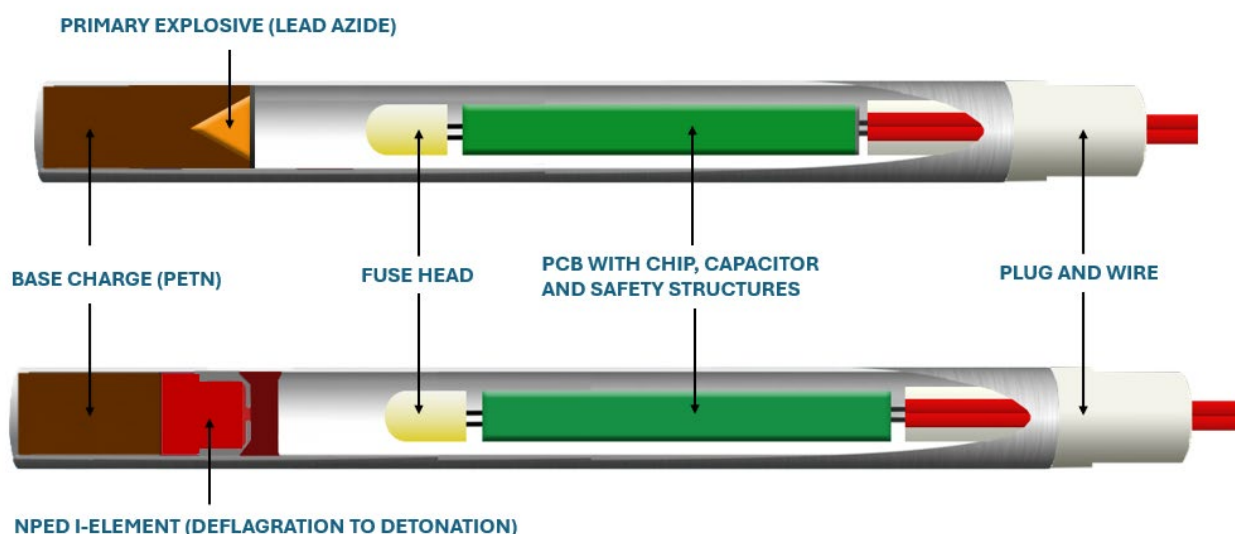
Detonators based on the NPED technology can be used for assembly of non-electric, electric and electronic detonators. Between 1993-2024 more than 700 million NPED detonators have been manufactured by Orica Sweden AB, for assembly of finished detonators and sales as components.

### 3.1.3 ELECTRONIC DETONATORS

Orica is on track to release a fully lead-free range of electronic blasting systems (EBS) detonators ahead of the April 2026 deadline under the following trade names: i-kon™ III Neo, uni tronic™ 600 Neo and eDev™ II Neo. The products utilise NPED technology and do not contain any lead or hexavalent chromium substances.

In May 2024<sup>13</sup>, Orica announced the on-going work and plans to expand to a fully lead-free EBS detonator range. The CE certification for the products was completed in February 2025, meaning an explosive notified body has reviewed and approved the technical design of the products allowing them to be placed on the EU market, see Annexures I and II for the certificates.

Figure 7 shows the schematic drawings over the lead-free EBS detonator compared to a traditional lead azide EBS detonator. Most of the components remain the same, except that the primary explosive lead azide has been replaced by an NPED initiation element.



*Figure 7: Schematic drawings over a traditional lead azide electronic detonator and a lead-free NPED electronic detonator.*

In the electronic detonator, the electric wires lead up to a printed circuit board with chip, capacitor and safety features. The heart of the system is the electronic timing module, offering up to 1000x greater accuracy and more timing flexibility than traditional pyrotechnic delay formulations. The circuit board is connected to a fusehead which is used for initiating the NPED I-element which in turn is used for initiating the base charge of the detonator.

As one of the industry leaders in EBS, Orica is constantly working to make the products safer, more reliable and more efficient. Orica has been researching the design and performance of electronic blasting systems since the 1980s. The development of the lead-free EBS range of detonators builds on years of experience in laboratory testing and use in the field. The NPED technology used for replacing lead azide is a reliable and proven solution.

### **3.1.4 ELECTRIC DETONATORS**

Orica Sweden AB has manufactured electric detonators based on the NPED technology since 1993. During 1993-2023 more than 90 million electric detonators have been placed on the market under the trade names VA detonator and Dynadet™. Figure 8 provides an overview of the technical design of a NPED electric detonator compared to a traditional lead azide electric detonator.

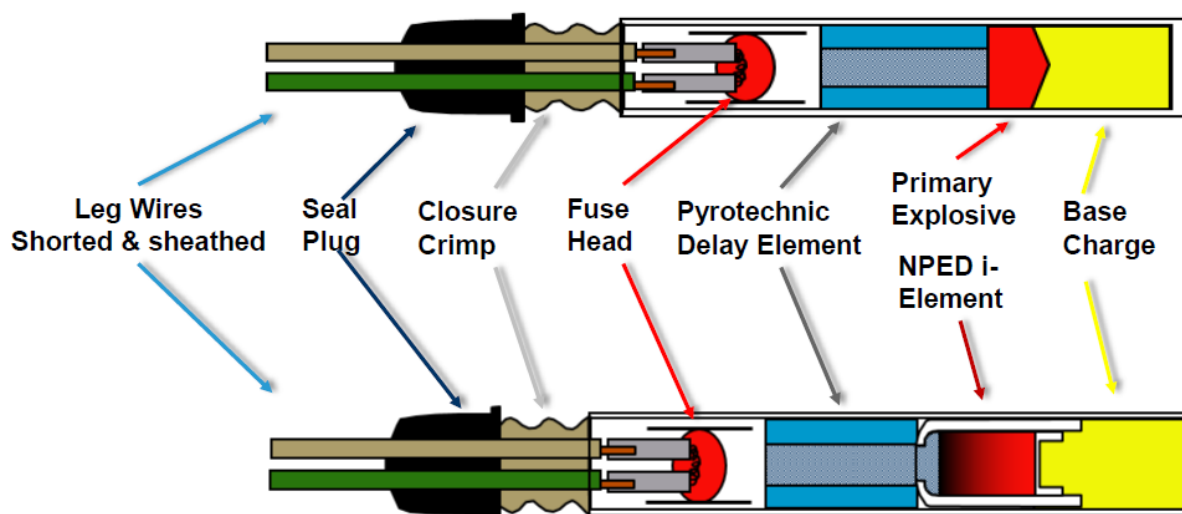


Figure 8: Schematic drawings over a traditional lead azide electric detonator and a lead-free NPED electric detonator.

In 2023 Orica Sweden AB ceased manufacturing and assembly of electric detonators in favor of electronic detonators. The NPED elemented cap, is still manufactured and sold for use in the assembly of electric detonators. On the global market, there is an on-going transition from electric detonators to electronic detonators driven by 1) the increased safety features in the new electronic detonators and 2) the electric detonators being more easily able to be manipulated for potential misuse. For example, in the People's Republic of China the government has banned manufacture, possession and import of electric detonators from April 2025 in view of security concerns and public safety, while India has a ban on electric detonators coming into affect in September 2025.

### 3.2 SUBSTITUTES FOR THE PRIMARY CHARGE USED IN FUSEHEADS

Fuseheads are available for a lot of different applications: pyrotechnic articles, fireworks, safety related products, special effects products, defence related products, weapons and arms and detonators for both civil- and military use. The substances lead azide, lead styphnate and lead dipicramate can be used in different compositions together with other substances to form the primary charge or pyrotechnic charge of a fusehead. Figure 9 provides an overview of the general design of a fusehead.

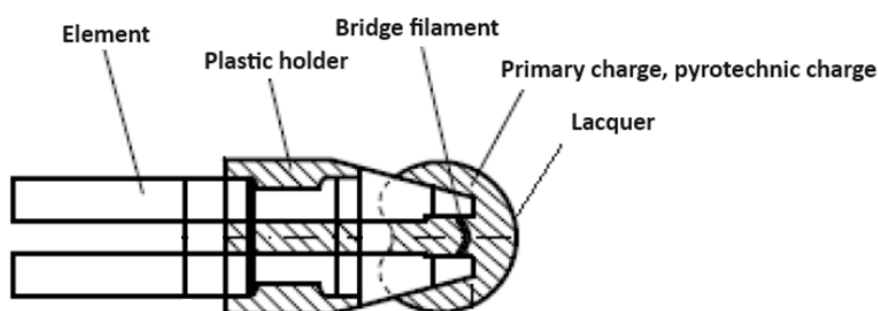


Figure 9: Schematic design of a fusehead.

Fuseheads generally comprise of two metal strips or elements. The elements are tinned and separated by an insulator or plastic holder between which a fine wire, called the bridge filament is welded or crimped. The end of the fusehead containing the bridge wire is then dipped in at least two distinct pyrotechnic compositions which are suspended in a binder and solvent. The inner or primary dip is designed to ignite quickly from the heat generated by the bridge wire when it is connected to an electrical source. The second dip is typically less sensitive than the primary one and designed to add heat energy to the ignition of the primary dip, and to provide some level of protection against

friction and degradation by moisture. Finally, lacquer, colouring agents and other additives may be added for additional protection and visibility for distinguishing between different types of fuseheads.

There are lead-free fuseheads available on the market that can possibly be used in electric- and electronic detonators, including an Asototec lead free fusehead being used by Orica. Table 1 gives a few examples of providers of lead-free alternatives based on a literature search. The complete references can be seen in the Annexure.

*Table 1: Possible providers of lead-free fuseheads.*

| Company                                          |
|--------------------------------------------------|
| Astotec Pyrotechnic Solutions GmbH <sup>14</sup> |
| Energetix Solutions Inc. <sup>15</sup>           |
| Fr. Sobbe GmbH <sup>16</sup>                     |
| Austin Powder Co. <sup>17</sup>                  |

### 3.3 SUBSTITUTES FOR THE PYROTECHNIC DELAY COMPOSITION USED IN ELECTRIC DETONATORS

Lead tetroxide, lead dioxide and barium chromate can be used in pyrotechnic delay compositions for both electric- and non-electric detonators. Orica Sweden AB stopped using barium chromate in the detonators more than 20 years ago.

In September 2023, Orica released the completely lead-free detonator range Exel™ <sup>18[OR]</sup>. Since the release, over 10 million lead-free Exel™ Neo detonators and over 20 million lead-free Exeldet Neo elemented caps have been manufactured. The elemented caps are available on the EU market and can be used for final assembly of both electric- and non-electric detonators, with sales in Greece, Turkey, Korea and the middle East. The CE certification for the completely lead-free technology was completed in July 2023, which means an explosive notified body, in this case Bundesanstalt für Materialforschung und-prüfung (BAM) has reviewed and approved the technical design of the products allowing them to be placed on the EU market. Refer to Annex II for the certificate.

The Exel™ Neo detonators and the elemented caps Exeldet Neo are based on proven NPED technology. Figure 10 provides an overview of the benefits and characteristics of the detonators.



High safety standards



Lead-free initiation



Consistent and reliable performance



Removing lead from the environment

### **MANUFACTURING**

- Safer to manufacture as no primary explosive is required
- Lead and lead compounds have been eliminated from the entire manufacturing process
- Reduced health hazard for people working in manufacture and production
- Manufactured in Europe for proximity to the customer base

### **APPLICATION**

- Safe and reliable initiation of explosives
- Overlap free, accurate delay times to achieve optimum blast results

### **ENVIRONMENT**

- Lead-free initiation of explosives
- For every 10.000 detonators manufactured we avoid introducing 1 kg of lead into the life cycle of the product
- No lead or lead oxides released into the environment during blasting
- No accumulation of lead or lead oxides in the environment after blasting
- Does not contain any Substances of Very High Concern (SVHC) according to the European REACH regulation

*Figure 10: Summary over the characteristics and benefits of the lead-free Exel™ Neo detonator range.*

## 4. CORRELATION WITH REACH REGULATION

The regulation on the registration, evaluation, authorisation and restriction of chemicals (REACH)<sup>19</sup> is the main EU law to protect human health and the environment from the risks that can be posed by chemicals.

Lead as a solid metal is included in the Candidate List of substances of very high concern (SVHC) for authorisation for being toxic to reproduction since 27 June 2018. In April 2023, the European chemicals agency (ECHA) recommended adding lead to the Authorisation List (REACH Annex XIV) based on prioritization supported by the opinion of the Member State Committee<sup>20</sup>. For the specific substances in this exemption, at least three of them have been included in the Candidate List since 2011 and 2012, see table 2 below.

**Table 2: Candidate list status for the substances in the current RoHS exemption.**

| Substance name                              | EC nr     | CAS nr     | Candidate List | Date of inclusion |
|---------------------------------------------|-----------|------------|----------------|-------------------|
| Lead diazide, lead azide                    | 236-542-1 | 13424-46-9 | x              | 19-Dec-2011       |
| Lead styphnate                              | 239-290-0 | 15245-44-0 | x              | 19-Dec-2011       |
| Lead dipicramate                            | -         | -          |                |                   |
| Lead dipicrate <sup>(a)</sup>               | 229-335-2 | 6477-64-1  | x              | 19-Dec-2011       |
| Orange lead (lead tetroxide) <sup>(b)</sup> | 215-235-6 | 1314-41-6  | x              | 19-Dec-2012       |
| Lead dioxide                                | 215-174-5 | 1309-60-0  |                |                   |
| Barium chromate                             | 233-660-5 | 10294-40-3 |                |                   |

(a) There is not much data present in the ECHA database for the substance lead dipicramate. Lead dipicrate is a more commonly used substance and closely related to lead dipicramate which is why this substance is provided for reference.

(b) The substance orange lead was recommended for inclusion in the Authorisation List, Annex XIV during the recommendation round 7, in 2015-2016.

REACH regulation requires that ECHA regularly recommends priority substances from the Candidate List for inclusion in the Authorisation List. The authorisation process aims to ensure that substances of very high concern are progressively replaced by less dangerous substances or technologies where technically and economically feasible alternatives are available. Manufacturers of EEE using the specific substances on the candidate list have been aware since 2011 and 2012 that these substances have been prioritized as substances of very high concern. Sufficient time has been given to the manufacturers to find suitable alternatives.

For barium chromate and other hexavalent chromium, Cr(VI) substances there is an on-going restriction proposal by ECHA for an EU-wide restriction. The aim is to reduce the harmful effects of these carcinogenic chemicals for both workers and the public.

## 5. SAFETY, HEALTH AND ENVIRONMENT

It has been more than 30 years since Orica Sweden AB introduced the NPED technology in detonators for civil use on the market. In 2023, completely lead-free detonators were released to the market under the Exel™ Neo branding and the semi-finished elemented caps under the Exeldet Neo branding for final assembly of both electric- and non-electric detonators. In 2024, Orica commenced testing completely lead-free electronic detonators and is moving towards commercialisation ahead of the April 2026 deadline. These changes have led to significant improvements for the safety and health of the workers and reduced the impact on the environment and public health more generally.

### 5.1 HEALTH AND SAFETY IN MANUFACTURING

The substances used in NPED detonator manufacturing processes are safer and less likely to be accidentally initiated. From 1893-2016 there are 27 documented fatalities related to the usage of lead azide according to the SAFEX International database<sup>21</sup>. By removing lead azide and other lead substances, there are reduced health hazards for the workers in production. For lead substances there are strict occupational exposure limits and controls must be in place to make sure there is no exposure. Each year, lead exposure leads to 5.5 million premature adult deaths from cardiovascular disease according to a recent study by Stephen P Luby et al.<sup>22</sup>. Regular health monitoring of the workers and blood testing is conducted to ensure that they have not been exposed to high levels of lead. Lead exposure has long been associated with a range of severe health issues.

Figure 71 shows the hierarchy of controls concept used in industry for managing risks. Often a combination of different engineering- and administrative controls, and personal protective equipment is used to control the hazards when using lead substances. These remain less effective than total elimination of the hazard, as intended in the RoHS directive.

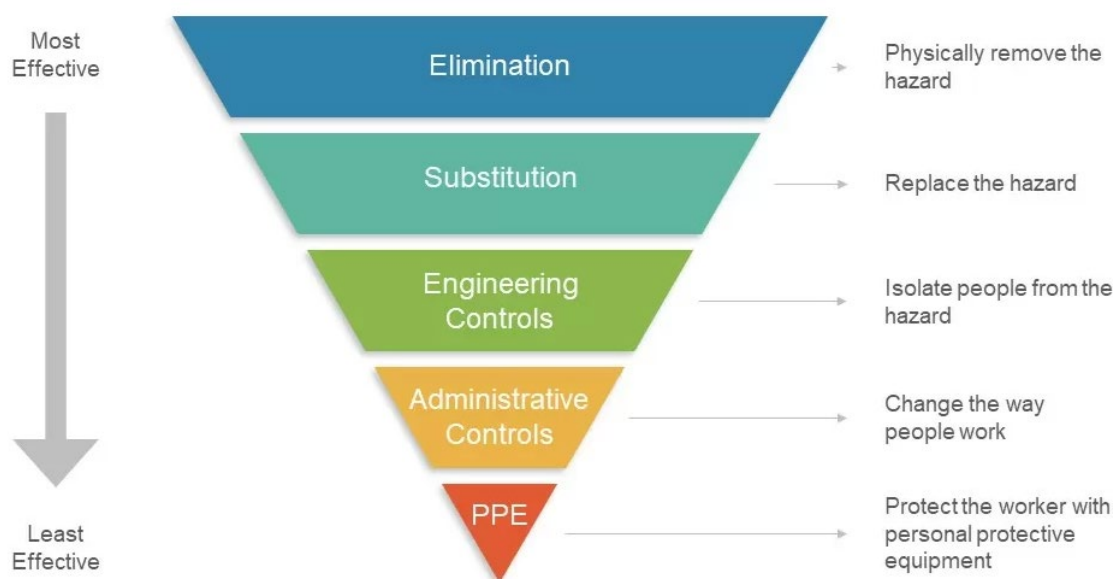


Figure 7: Hierarchy of controls concept used in risk management.

## 5.2 BENEFITS FOR THE ENVIRONMENT AND FOR HUMAN HEALTH

The removal of lead substances from manufacturing processes and from the final products' use in civil applications provides significant benefits for the environment and ultimately for the protection of human health.

The elimination of lead from manufacturing contributes to a cleaner and safer environment and ensures compliance with health and environmental regulations. Orica Sweden AB has reduced the amount of lead used by 1.5 tonnes per year at the initiating systems manufacturing plant in Gytting, Sweden. For every 10 000 lead-free detonators manufactured at the plant, 1 kg of lead will not be introduced into the life cycle of the product. By removing lead from the products, there are no lead oxides released into the environment during blasting by the end-users.

Lead can contaminate air, soil, and water. Lead contamination in water sources is a concern, as it poses a direct threat to human health and to aquatic life. Lead can leach into drinking water supplies through industrial waste. The removal of lead from manufacturing processes reduces the risk of lead entering water bodies, ensuring that drinking water is free from harmful contaminants. Additionally, it protects aquatic ecosystems by preventing the accumulation of lead in sediments and organisms, which can disrupt biodiversity and ecosystem stability. Replacing lead minimizes the risk of contaminating air, soil, and water, and in this way protects biodiversity and safeguards EU agriculture, supporting the production of safe, healthy food.

Manufacturing processes that involve lead generate hazardous waste, which requires careful handling, disposal, and storage to prevent environmental contamination and creating long-term environmental issues. By removing lead from manufacturing, the volume of hazardous waste generated is reduced, improving waste management practices.

Collectively, these benefits enable the protection and safeguarding of human health and the environment. This was the objective Directive 2011/65/EU was intended to achieve and for which adequate time has been provided for industry to action given the availability of substitutes.

## 5.3 REGULATORY COMPLIANCE AND CORPORATE RESPONSIBILITY

The use of lead substances in manufacturing is increasingly regulated worldwide and, in the EU, due to its environmental and health risks. By proactively removing lead from manufacturing, industries can demonstrate compliance with these evolving regulations. This aligns with wider corporate social responsibility (CSR) initiatives. Companies operating in the EU are required to take proactive measures to ensure that their products and manufacturing processes comply with regulations on lead usage and disposal. This includes making risk assessments and implementing substitution strategies for safer materials where possible. Often there are strict requirements under the national environmental permits for the sites to be able to use lead substances in manufacturing. Even if not considering the requirements under the RoHS directive, lead and other substances of very high concern under REACH regulation need to be regularly reviewed for alternatives to meet requirements under other legislations.

## **6. SOCIO-ECONOMIC IMPACTS OF SUBSTITUTION**

### **6. 1 INVESTMENT IN LEAD-FREE TRANSFORMATION**

For Orica Sweden AB, which has proactively eliminated lead-based substances from its products and processes, the socio-economic impact has been both substantial and positive. The transition required significant upfront investment—in financial resources, time, and technical expertise. The company allocated AUD8M (~4.46M EUR) to research and development, process modifications, and compliance with regulatory standards, with over 30,000 hours invested.

Despite these early costs, the long-term benefits - both for the company and for society - are expected to far outweigh the initial investment. By phasing out lead, Orica has contributed to improved public health, reduced environmental pollution, and enhanced workplace safety. The company's commitment to sustainability has not only reduced risk but also strengthened its brand reputation, increased consumer trust, and opened access to markets where lead-free products are required. We are proud of our investment and the results.

This forward-looking investment strategy illustrates how aligning business operations with environmental and societal goals can deliver lasting value.

### **6.2 WORKFORCE AND COMMUNITY ENGAGEMENT**

The transition process has also had positive impacts internally in the company. The commitment to sustainability and employee health has fostered a stronger sense of purpose within the workforce. Orica invested in training programs to ensure that the employees had the necessary skills to adapt to the new processes and technologies.

The work has contributed to creating jobs in industries focused on sustainable materials and technologies, benefiting local economies. The efforts in lead substitution have also opened opportunities for collaboration with other companies, associations and governments to further promote environmental and health initiatives.

A majority of the products manufactured at the Orica plant in Sweden is for use in the EU market but millions of detonators and components are exported outside of the EU, generating awareness of the lead-free solutions on a global scale. Over time, Orica intends to consider building on this capability outside of the EU and in its manufacturing facilities around the world, reflecting the impact of Europe's approach to regulation driving sustainable change and improvement around the world.

## 7. REFERENCES

- <sup>1</sup> Commission delegated directive (EU) 2021/647 of 15 January 2021 amending, for the purposes of adapting to scientific and technical progress, Annex III to Directive 2011/65/EU as regards an exemption for the use of certain lead and hexavalent chromium compounds in electric and electronic initiators of explosives for civil (professional) use.
- <sup>2</sup> 'Electrical and electronic equipment' or 'EEE' means equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current.
- <sup>3</sup> Robert Matyáš, Jiří Pachman, Primary Explosives, Springer-Verlag Berlin Heidelberg, 2013.
- <sup>4</sup> G. E. Mavrodi, Improvements in or relating to explosives of the organic peroxide class. GB Patent 620,498, 1949.
- <sup>5</sup> Jenkins, J.M., Proceedings of International Conference on Research in Primary Explosives, vol. 2, pp. 12/1–12/20, 1975.
- <sup>6</sup> Griess, P., Vorläufige Notiz über die Einwirkung von salpetriger Säure auf Aminotrophenylsäure. Annalen der Chemie und Pharmacie 106, 123–125 (1858).
- <sup>7</sup> Fedoroff, B.T., Encyclopedia of Explosives and Related Items. Picatinny Arsenal, New Jersey (1960–1983).
- <sup>8</sup> Sheng D, Zhu Y, Pu Y. Development of a new-generation primary explosives designing and synthesis. Chin. J. Energ. Mater. 2012;20:263–272.
- <sup>9</sup> Hariharanath, B.: Detonator using nickel hydrazine nitrate as primary explosive. Defence Sci. J. 56, 383–389 (2006).
- <sup>10</sup> Thangadurai, S. et al., Review of some newly synthesized high energetic materials. Sci. Technol. Energetic Mater. 65, 215–226 (2004).
- <sup>11</sup> Talawar, M.B. et al., Studies on nickel hydrazinium nitrate (NHN) and bis-(5-nitro-2H tetrazolato-N2) tetraamino cobalt(III) perchlorate (BNCP): Potential lead-free advanced primary explosives. J. Sci. Ind. Res. 63, 677–681 (2004).
- <sup>12</sup> US Patent 4,727,808, issued March 1, 1988 to Wang et al.
- <sup>13</sup> <https://www.orica.com/news-media/2024/orica-to-expand-fully-lead-free-detonator-technology-to-its-electronic-blasting-systems-range>
- <sup>14</sup> Astotec Holding GmbH, accessed at 2025-02-03, <<https://pyrotechnic.astotec.com/en/productoverview/>>
- <sup>15</sup> Energetixsolutions, accessed at 2025-02-03, <<https://energetixsolutions.com/lead-free-series-electric-fusehead-igniter/>>
- <sup>16</sup> Fr. Sobbe GmbH, accessed at 2025-02-03, <<https://www.sobbe-zuender.de/en/product-ranges/electrical-detonators/>>
- <sup>17</sup> Austin Powder, accessed at 2025-02-03 <<https://austinpowder.com/sustainable-products/?language=English>>
- <sup>18</sup> Orica Limited, 2023, accessed at 2025-02-03, <<https://www.orica.com/news-media/2023/orica-launches-exel-neo-the-worlds-first-lead-free-non-electric-detonator-range>>
- <sup>19</sup> Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).
- <sup>20</sup> Recommendations for Inclusions in the Authorisation List, European Chemicals Agency, accessed 2025-07-15. <<https://www.echa.europa.eu/recommendations-for-inclusion-in-the-authorisation-list>>
- <sup>21</sup> Lead Azide Explosions, Incidents and causes, SAFEX International database.
- <sup>22</sup> Stephen P Luby et al., Removing lead from the global economy, The Lancet Planetary Health, Volume 8, Issue 11, 2024, Pages e966-e972, ISSN 2542-5196.

# ANNEX I: CE CERTIFICATE FOR LEAD FREE ELECTRONIC DETONTATOR (EBS NEO)

The EU-type examination certificate (module B), which includes the completely lead-free electronic detonators was issued 2025-02-25.



## EU-Baumusterprüfbescheinigung (Modul B) Nr.

*EU-type examination certificate (Module B) no.*

**0589.EXP.0961/24**

Bezeichnung des Explosivstoffs (Handelsname):

*Name of the explosive (trade name):*

**i-kon III Neo  
uni tronic 600 Neo  
eDev II Neo**

Typ des Explosivstoffs:

**Elektronischer Zünder**

*Type of the explosive:*

**Electronic detonator**

Hersteller (Name/Firma und Anschrift):

*Manufacturer (name/company and address):*

**Orica Canada Inc.  
301 rue Hotel de Ville  
Brownsburg-Chatham, Quebec J8G 3B5  
Kanada**

EU-Baumusterprüfbescheinigung Nr. 0589.EXP.0961/24  
EU-type examination certificate no. 0589.EXP.0961/24

Die Bundesanstalt für Materialforschung und –prüfung (BAM) bescheinigt, dass der oben bezeichnete Explosivstoff (Baumuster) die wesentlichen Sicherheitsanforderungen nach Anhang II der Richtlinie 2014/28/EU des europäischen Parlaments und des Rates vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten über die Bereitstellung auf dem Markt und die Kontrolle von Explosivstoffen für zivile Zwecke (Neufassung) (ABl. L 96 vom 29.3.2014, S. 1) erfüllt.

Die Konformitätsbewertung erfolgt durch die Bundesanstalt für Materialforschung und –prüfung (BAM) als Benannte Stelle nach Artikel 24 der Richtlinie 2014/28/EU und als die für die Erteilung von EU-Baumusterprüfbescheinigungen für Explosivstoffe zuständige Stelle nach § 5e Sprengstoffgesetz in der Fassung der Bekanntmachung vom 10. September 2002 (BGBl. I S. 3518), das zuletzt durch Artikel 6 des Gesetzes vom 25. Oktober 2024 (BGBl. 2024 I Nr. 332) geändert worden ist.

Der Entscheidung liegen die der Bundesanstalt für Materialforschung und –prüfung (BAM) eingereichten Unterlagen und Angaben zugrunde.

Die Konformität der nachgefertigten Produkte mit dem Baumuster ist nach Artikel 20 der Richtlinie 2014/28/EU sowie nach § 5c des SprengG sicherzustellen.

Die Prüfergebnisse sind in dem vertraulichen Prüfbericht mit folgender Nummer niedergelegt:

**P 0961/24**

Die Prüfergebnisse sind in dem vertraulichen Bewertungsbericht mit folgender Nummer bewertet:

**B 0961/24**

Die für die Identifikation des oben bezeichneten Explosivstoffes notwendigen Angaben sind in der Anlage 1 zu dieser Bescheinigung enthalten.

Hinweise zur sicheren Handhabung für den oben bezeichneten Explosivstoff sind in der Anlage 2 zu dieser Bescheinigung enthalten. Bei Weitergabe dieser Bescheinigung ist die Anlage 2 beizufügen.

Die Erfüllung der Anforderungen der Richtlinien 2014/28/EU und 2008/43/EG hinsichtlich der Kennzeichnung, Identifizierung und Rückverfolgbarkeit der Explosivstoffe ist im Rahmen der Überwachung der Qualitätssicherung nachzuweisen.

The Bundesanstalt für Materialforschung und –prüfung (BAM) certifies, that the above named explosive (type) satisfies the essential safety requirements set out in Annex II of the Directive 2014/28/EU of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market and supervision of explosives for civil uses (recast) (OJ L 96, 29.3.2014, p. 1).

The conformity assessment was done by the Bundesanstalt für Materialforschung und –prüfung (BAM) as Notified Body in accordance with article 24 of the Directive 2014/28/EU and put in charge by the German Explosives Act (for detailed references see German text) for the issuing of EU-type examinations.

The decision was made on the basis of documents and information provided to Bundesanstalt für Materialforschung und –prüfung (BAM).

The conformity of later manufactured products with the type shall be guaranteed in accordance with article 20 of the Directive 2014/28/EU.

The test results are contained in the confidential test report with the number given below:

The test results are assessed in the confidential assessment report with the number given below:

Information required for the identification of the above named explosive is contained in Annex 1 to this certificate.

Hints for safe handling for the above named explosive are contained in Annex 2 to this certificate. In the case the certificate is circulated Annex 2 has to be attached.

Conformity of the explosive with the requirements of Directives 2014/28/EU and 2008/43/EC concerning labelling, identification, and traceability shall be demonstrated under the quality assurance monitoring process.

EU-Baumusterprüfbescheinigung Nr. 0589.EXP.0961/24  
EU-type examination certificate no. 0589.EXP.0961/24

Änderungen der Zusammensetzung und Beschaffenheit des Explosivstoffes sind der Bundesanstalt für Materialforschung und –prüfung (BAM) mitzuteilen.

Diese EU-Baumusterprüfbescheinigung ist unbefristet in den Mitgliedsstaaten der Europäischen Union gültig.

Die englische Fassung dient ausschließlich zu Informationszwecken; bindend ist allein die deutsche Fassung.

#### **Rechtsbehelfsbelehrung**

Gegen diesen Bescheid kann innerhalb eines Monats nach Bekanntgabe Widerspruch bei der Bundesanstalt für Materialforschung und –prüfung (BAM), Unter den Eichen 87, 12205 Berlin, erhoben werden.

Der Präsident der Bundesanstalt für Materialforschung und –prüfung (BAM)

im Auftrag

25.02.2025



Dr. Christian Lohrer

Diese EU-Baumusterprüfbescheinigung besteht aus 3 Seiten und 2 Anlagen mit 4 Seiten.

Changes of the composition and design of the explosive have to be communicated to the Bundesanstalt für Materialforschung und –prüfung (BAM).

This EU-type examination certificate is valid temporarily unlimited within the member states of the European Union.

The English translation exclusively serves informational purposes; solely the German version is binding.

#### **Legal remedies**

Objections to this notice may be filed within one month after its announcement at the Bundesanstalt für Materialforschung und –prüfung (BAM), Unter den Eichen 87, 12205 Berlin.

The President of the Bundesanstalt für Materialforschung und –prüfung (BAM)

by order

This EU-type examination certificate comprises 3 pages and 2 Annexes with 4 pages.

# ANNEX II: CE CERTIFICATE FOR ELECTRIC DETONATOR (EXEDET NEO)



## 3. Ergänzung zur EU-Baumusterprüfbescheinigung (Modul B) Nr.

*Amendment no. 3 to the EU-type examination certificate (Module B) no.*

**0589.EXP.2783/18**

Bezeichnung des Explosivstoffs (Handelsname):

*Name of the explosive (trade name):*

**Exel MS, Exel MS 1000 Cu,  
Exel LP,  
Exel Connectadet SL, Exel Connectadet SL LA,  
Exel B Connector, Exel B Connector SL,  
Exel Lead-in line,  
Exel Starter, Exel Starter SL,  
Exel Handidet SL, Exel Handidet SL LA,  
Exeldet MS, Exeldet MS Neo,  
Exeldet LP, Exeldet LP II, Exeldet LP Neo,  
Exeldet sNPED, Exeldet sNPED Neo,  
Exeldet UX, Exeldet UX Neo,  
Exel Shock tube 3L**

Typ des Explosivstoffs:

**Nichtelektrischer Zünder**

*Type of the explosive:*

**Non-electric detonator**

Hersteller (Name/Firma und Anschrift):

*Manufacturer (name/company and address):*

**Orica Sweden AB  
Gyttorp  
713 82 Nora  
Schweden**

Nr. der EU-Baumusterprüfbescheinigung:

*No. of the EU-type examination certificate:*

**0589.EXP.2783/18**

Ausstellungsdatum der EU-Baumusterprüfbescheinigung:

*Date of issue of the EU-type examination certificate:*

**28. März 2019**

3. Ergänzung zur EU-Baumusterprüfbescheinigung Nr. 0589.EXP.2783/18  
*Amendment no. 3 to the the EU-type examination certificate no. 0589.EXP.2783/18*

Die Bundesanstalt für Materialforschung und –prüfung (BAM) bescheinigt, dass der oben bezeichnete Explosivstoff (Baumuster) die wesentlichen Sicherheitsanforderungen nach Anhang II der Richtlinie 2014/28/EU des europäischen Parlaments und des Rates vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten über die Bereitstellung auf dem Markt und die Kontrolle von Explosivstoffen für zivile Zwecke (Neufassung) (ABl. L 96 vom 29.3.2014, S. 1) erfüllt.

Die Konformitätsbewertung erfolgt durch die Bundesanstalt für Materialforschung und –prüfung (BAM) als Benannte Stelle nach Artikel 24 der Richtlinie 2014/28/EU und als die für die Erteilung von EU-Baumusterprüfbescheinigungen für Explosivstoffe zuständige Stelle nach § 5e Gesetzes über explosionsgefährliche Stoffe (Sprengstoffgesetz – SprengG) in der Fassung der Bekanntmachung vom 10. September 2002 (BGBl. I S. 3518), das zuletzt durch Artikel 11 des Gesetzes vom 2. März 2023 (BGBl. 2023 I Nr. 56) geändert worden ist.

Der Entscheidung liegen die der Bundesanstalt für Materialforschung und –prüfung (BAM) eingereichten Unterlagen und Angaben zugrunde.

Die Konformität der nachgefertigten Produkte mit dem Baumuster ist nach Artikel 20 der Richtlinie 2014/28/EU sowie nach § 5c des SprengG sicherzustellen.

The Bundesanstalt für Materialforschung und –prüfung (BAM) certifies, that the above named explosive (type) satisfies the essential safety requirements set out in Annex II of the Directive 2014/28/EU of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market and supervision of explosives for civil uses (recast) (OJ L 96, 29.3.2014, p. 1).

The conformity assessment was done by the Bundesanstalt für Materialforschung und –prüfung (BAM) as Notified Body in accordance with article 24 of the Directive 2014/28/EU and put in charge by the German Explosives Act (for detailed references see German text) for the issuing of EU-type examinations.

The decision was made on the basis of documents and information provided to Bundesanstalt für Materialforschung und –prüfung (BAM).

The conformity of later manufactured products with the type shall be guaranteed in accordance with article 20 of the Directive 2014/28/EU.

**Inhalt der Ergänzung**

Es werden die Kapseln Exeldet MS Neo, Exeldet LP Neo, Exeldet sNPED Neo sowie Exeldet UX Neo zu dieser EU-Baumusterprüfbescheinigung hinzugefügt.

Die Prüfergebnisse sind in dem vertraulichen Prüfbericht Nr. P 0539/23 niedergelegt.

Die Prüfergebnisse sind in dem vertraulichen Bewertungsbericht Nr. B 0539/23 bewertet.

Die für die Identifikation des oben bezeichneten Explosivstoffs notwendigen Angaben sind in der Anlage 1 zu dieser Bescheinigung enthalten.

Hinweise zur sicheren Handhabung für den oben bezeichneten Explosivstoff sind in der Anlage 2 zu dieser Bescheinigung enthalten. Bei Weitergabe dieser Bescheinigung ist die Anlage 2 beizufügen.

**Subject of the amendment**

The elemented caps Exeldet MS Neo, Exeldet LP Neo, Exeldet sNPED Neo as well as Exeldet UX Neo are added to this EU type-examination certificate.

The test results are contained in the confidential test report No P 0539/23.

The test results are assessed in the confidential assessment report No. B 0539/23.

Information required for the identification of the above named explosive is contained in Annex 1 to this certificate.

Hints for safe handling for the above named explosive are contained in Annex 2 to this certificate. In the case the certificate is circulated Annex 2 has to be attached.

3. Ergänzung zur EU-Baumusterprüfbescheinigung Nr. 0589.EXP.2783/18  
*Amendment no. 3 to the EU-type examination certificate no. 0589.EXP.2783/18*

Die Konformität des Baumusters wird durch den Inhalt dieser Ergänzung nicht beeinflusst und besteht weiterhin.

Änderungen der Zusammensetzung und Beschaffenheit des Explosivstoffes sind der Bundesanstalt für Materialforschung und –prüfung (BAM) mitzuteilen.

Diese EU-Baumusterprüfbescheinigung ist unbefristet in den Mitgliedsstaaten der Europäischen Union gültig.

Die englische Fassung dient ausschließlich zu Informationszwecken; bindend ist allein die deutsche Fassung.

**Rechtsbehelfsbelehrung**

Gegen diesen Bescheid kann innerhalb eines Monats nach Bekanntgabe Widerspruch bei der Bundesanstalt für Materialforschung und –prüfung (BAM), Unter den Eichen 87, 12205 Berlin, erhoben werden.

Der Präsident der Bundesanstalt für Materialforschung und –prüfung (BAM)

im Auftrag

13.07.2023



Dr. Christian Lohrer

Diese Ergänzung zur EU-Baumusterprüfbescheinigung besteht aus 3 Seiten und 2 Anlagen mit 9 Seiten.

Conformity of the type with the Directive is not altered by this amendment and continues to be met.

Changes of the composition and design of the explosive have to be communicated to the Bundesanstalt für Materialforschung und –prüfung (BAM).

This EU-type examination certificate is valid temporarily unlimited within the member states of the European Union.

The English translation exclusively serves informational purposes; solely the German version is binding.

**Legal remedies**

Objections to this notice may be filed within one month after its announcement at the Bundesanstalt für Materialforschung und –prüfung (BAM), Unter den Eichen 87, 12205 Berlin.

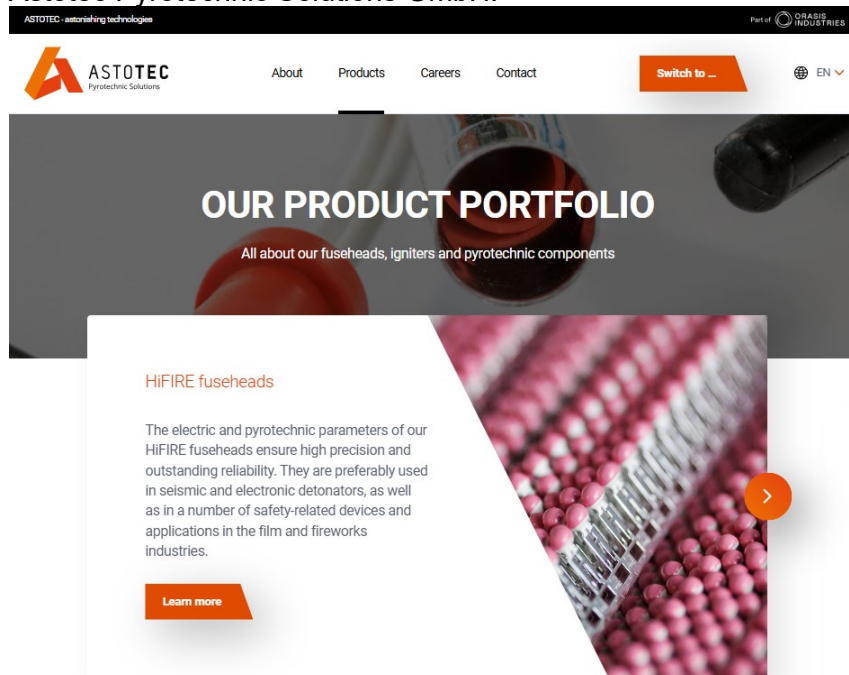
The President of the Bundesanstalt für Materialforschung und –prüfung (BAM)

by order

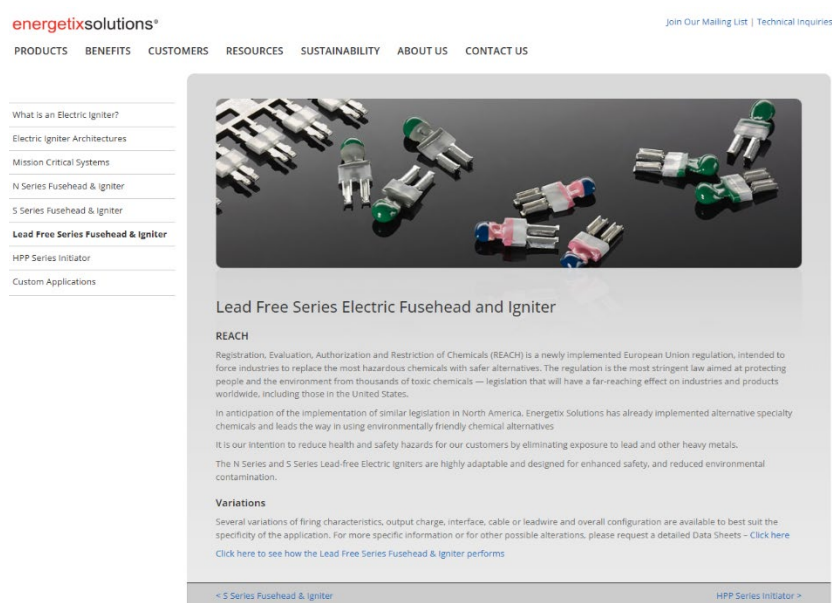
This amendment to the EU-type examination certificate comprises 3 pages and 2 Annexes with 9 pages.

# ANNEX III : REFERENCES FOR LEAD-FREE FUSEHEAD PROVIDERS

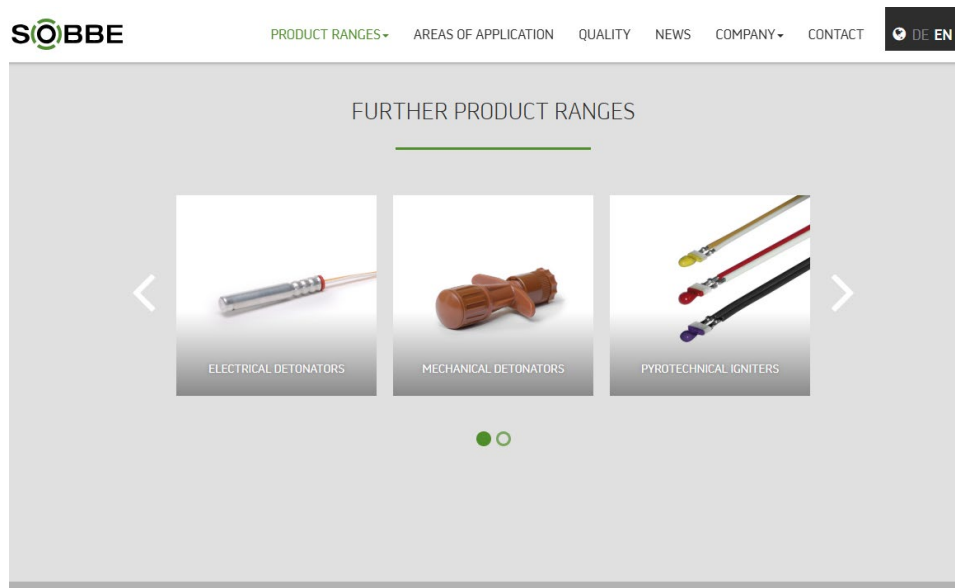
## Astotec Pyrotechnic Solutions GmbH:



## Energetix Solutions Inc.:



Fr. Sobbe GmbH:



Austin Powder:

