



Nederlands Forensisch Instituut
Ministerie van Justitie en Veiligheid

Factsheet

Danger assessment of Super COBRA 6 and similar fireworks



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1. Factsheet in general

The Netherlands Forensic Institute (NFI) conducts a wide variety of investigations. An investigation report from the NFI may be accompanied by a factsheet. This serves as (additional) background information and is of an informative character.

2. Introduction

The expert area of Explosions and Explosives at the NFI frequently receives questions about the dangers of fireworks. A dangerous firework article that frequently appears in the Netherlands is the COBRA 6. This firework article and its effects have been investigated by the NFI. This factsheet summarizes the research results with the aim of providing a general overview of the dangers of an exploding COBRA 6 and similar firework articles.

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3. Description Super COBRA 6

3.1. Other firework articles with the name COBRA

There are various firework articles with a name that includes 'COBRA'. This factsheet specifically concerns the 'Super COBRA 6'. The information presented also applies to firework articles with a comparable amount of charge and a similar internal structure to the Super COBRA 6 articles described in this factsheet. In case of doubt, you can contact the NFI.

3.2. External characteristics and internal structure of the Super COBRA 6 (with effect charge)

The Super COBRA 6 (with effect charge) is a pyrotechnic article¹ consisting of a cardboard tube with a black paper label (see photo 1). This label always features the name 'Super COBRA 6' and an illustration of a green snake. The font, colors, and design details may vary, as can the language and wording of the text present on the label².



Photo 1. Example of an intact Super COBRA 6.

Photo 2. Internal structure of the Super COBRA 6 shown in photo 1.

The internal structure of the Super COBRA 6 is visible in photo 2 and is schematically illustrated in figure 7: A cardboard tube of approximately 13 centimeters in length and around 3 centimeters in diameter is sealed at one end with a plastic cap. This cap is often blue, although the NFI has also encountered white-transparent, grey, purple-blue, and black caps. The other end of the tube is sealed with a lump of compressed black powder³, serving as the effect charge. Based on various Super COBRA 6 articles examined by the NFI, it is known that the tube is

further filled with approximately 15 to 35 grams of grey powder with the composition of flash powder⁴. A green firework fuse lies against the lump of compressed black powder and is held in place by the adhesive side of the label.

3.3. Variations in the internal structure of the Super COBRA 6 (with clay plugs)

The NFI has also examined variants of the Super COBRA 6 that use white and/or red clay plugs as sealing material (see, for example, photos 3 through 6). The variants investigated by the NFI contained approximately 18 to 40 grams of flash powder.



Photo 3. Example of an intact Super COBRA 6 with white clay plugs.
Photo 4. Internal structure of the Super COBRA 6 shown in photo 3.



Photo 5. Example of an intact Super COBRA 6 with red clay plugs.
Photo 6. Internal structure of the Super COBRA 6 shown in photo 5.

The internal structure of these Super COBRA 6 variants with clay plugs differs significantly from that of the Super COBRA 6 shown in photo 1. For clarification, the internal structures of the articles shown in photos 1 and 5 are schematically illustrated in figures 7 and 8. The internal

¹ A pyrotechnic article is a device containing a pyrotechnic charge. A pyrotechnic charge is a single substance or - in almost all cases - a mixture of two or more substances which together form an (explosive) flammable material. Pyrotechnic mixtures can for example be used in fireworks and firearms. Mixtures of this kind comprise at least one substance which serves as fuel (reductor) and one substance that serves as oxygen supplier (oxidizer).

² K. Bezemer et al., Forensic Science International (Elsevier) 290 (2018) 327-335, "Multicomponent characterization and differentiation of flash bangers – Part 1: Sample collection and visual examination".

³ Black powder is a pyrotechnic mixture consisting of sodium- or potassium nitrate and charcoal, with or without sulfur (mostly with).

⁴ In this factsheet, flash powder refers to a pyrotechnic mixture consisting of potassium perchlorate (oxidizer) with a metal powder (fuel) which may or may not be mixed with sulphur (fuel). In most cases, the Super COBRA 6 contains a mixture of potassium perchlorate and aluminium, but there are other compositions of flash powder. The precise composition of the flash powder in a Super COBRA 6 has no significant influence on the hazards in the event of an explosion.

structure of the Super COBRA 6 in photo 3 is somewhat similar to that in photo 5. Note: the Super COBRA 6 in photo 5 does not contain a plastic cap.

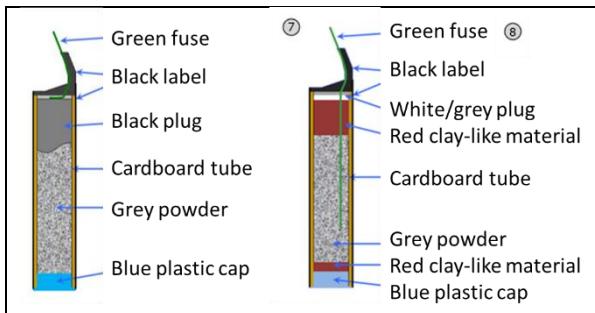


Figure 7. Schematic overview of the Super COBRA 6 shown in photo 1.

Figure 8. Schematic overview of the Super COBRA 6 shown in photo 5.

In the Super COBRA 6 articles with clay plugs, there is no lump of compressed black powder present. However, a thin, compressed layer of effect charge is often found on top of the clay plug near the fuse (for example, the white/grey layer in figure 8). Another important difference is that the green firework fuse passes through the clay plug and extends into the flash powder.

3.4. External characteristics and internal structure of the Super COBRA 6 2G (without effect charge)

The Super COBRA 6 2G is shown in photo 9 (intact) and photo 10 (internal structure).



Photo 9. Example of an intact Super COBRA 6 2G.

Photo 10. Internal structure of the Super COBRA 6 2G.

The Super COBRA 6 2G consists of a cardboard tube with a plastic cap at both ends, usually blue. A green firework fuse protrudes through one of these caps directly into the flash powder contained within the tube. The various Super COBRA 6 2G specimens examined by the NFI contained approximately 25 to 30 grams of flash powder.

3.5. Variations and similar articles

For all variants of the Super COBRA 6 (2G) as described in sections 3.2 through 3.4, there are additional firework articles—under names other than COBRA 6—that have a similar internal structure and therefore pose a similar level of danger. Based on past or new investigations, the NFI is able to determine whether a specific article also belongs to this category.

3.6. Legal aspects in the Netherlands

The Super COBRA 6 (2G) is industrially manufactured as a firework article. According to the Dutch Fireworks Decree, fireworks are defined as “pyrotechnic articles intended for entertainment.” In short, a pyrotechnic article such as the Super COBRA 6 (2G) can only be classified as a firework if it is used for entertainment purposes. Whether a Super COBRA 6 (2G) meets this definition depends on the specific context and circumstances of the case. It is ultimately up to the court to decide. Upon request, the NFI can assess the article against the Dutch Fireworks Decree and the RAC⁵ or, for example, the Weapons and Ammunition Act, depending on the apparent intent of the user.

It is important to note that—assuming the Super COBRA 6 (2G) qualifies as a firework—it is always classified as a professional firework under the Dutch Fireworks Decree⁶. This is because tubes containing several tens of grams of flash powder always pose a significant danger and are intended exclusively for use by individuals with specialized knowledge (in accordance with Article 1.1.2a of the Dutch Fireworks Decree). The Super COBRA 6 (2G) should therefore never be made available to the general public.

4. Danger assessment Super COBRA 6

4.1. Functioning and effects

The intended operation of a Super COBRA 6 with a lump of compressed black powder (see figure 7) is as follows: the green firework fuse is ignited and burns until the flame front reaches the black powder. This compressed lump of black powder does not explode but burns with an orange-red flame. The function of the compressed black powder is that of a color-effect charge. This effect charge also delays the detonation, because only once the black powder has completely burned (which usually takes between 10 to 20 seconds) does the flash powder detonate instantly with a very loud bang and a flash of white light. This produces heat, flames, and a pressure wave. The Super COBRA 6 is ripped apart, and the hot cardboard and plastic fragments are thrown out.

⁵ RAC = Regulation on the Designation of Consumer Fireworks pursuant to Article 1.1.1 and Article 2.1.1 of the Dutch Fireworks Decree.

⁶ Upon request, the NFI can provide a full substantiation in the form of an assessment against the Dutch Fireworks Decree.

The intended functioning of a Super COBRA 6 with clay plugs (see figure 8) is as follows: the green firework fuse is ignited and burns until the flame front reaches the flash powder inside the tube. During the burn, the flame front may ignite the thin compressed layer of effect charge (if present). This effect charge produces a colored flame (typically green or red), while the fuse continues to burn internally.

The total burn time depends on the length of the fuse and is typically between approximately 5 and 10 seconds. Once the flame reaches the flash powder, it detonates instantaneously with a very loud bang and a flash of light. This produces heat, fire effects, and a pressure wave. The Super COBRA 6 then bursts apart, ejecting hot fragments of cardboard, clay, and plastic.

The functioning of a Super COBRA 6 2G (see photo 9) is similar to that of the Super COBRA 6 with clay plugs, including the fuse burn time, but without the ignition of an effect charge and without the dispersion of clay fragments.

4.2. Mass explosivity

A cardboard tube containing several tens of grams of flash powder can, under certain conditions, exhibit mass explosive behavior. This means that a Super COBRA 6 (2G) can detonate simultaneously with one or more other flash powder-containing articles when they are located in very close proximity to each other. In such cases, the flash powder in the other articles is not ignited by a fuse, but by the detonation of another Super COBRA 6 (2G). Similarly, another sufficiently powerful explosion in the immediate vicinity of one or more Super COBRA 6 (2G) articles may trigger them to detonate simultaneously. This characteristic contributes to a higher danger level and is relevant in cases involving more than one Super COBRA 6 (2G), or a Super COBRA 6 (2G) located near other flash powder-containing articles (e.g. in a storage location or a backpack).

4.3. Dangers during the explosion of the Super COBRA 6 (2G)

The danger posed by a detonating Super COBRA 6 (2G) depends on many factors⁷. It is not possible to cover all possible scenarios in this factsheet. Therefore, this paragraph provides a general overview of the potential

dangers. If more specific information is required (e.g. in a criminal case), a formal investigation request can be submitted to the NFI.

In the case of a Super COBRA 6 with a lump of black powder or a thin effect charge layer, there is an initial danger of fire and burns caused by the flame. The flame may also lead individuals to mistakenly perceive the article as a (pyrotechnic) flare, thereby underestimating the danger and coming into direct contact with—or standing very close to—the article when it detonates. There have been documented cases of people kicking a burning Super COBRA 6, picking it up, or holding it in their hands at the moment it explodes.

When a Super COBRA 6 (2G) detonates, it poses a danger to both people and property in the immediate vicinity. If a Super COBRA 6 (2G) explodes directly against an object, that object will almost always be damaged. The level of injury for individuals depends in part on their position relative to the explosion. For example, if a person is in physical contact with a Super COBRA 6 (2G) at the moment of detonation, the resulting pressure wave and heat can cause severe to very severe physical injury⁸. In cases of (almost) direct contact with the head, neck, or torso of an unprotected person, the explosion may even result in fatal injuries⁹. At greater distances, the level of injury caused by heat and pressure depends on the specific circumstances. The heat released by the explosion can ignite highly flammable materials in the surroundings (e.g. synthetic clothing), leading to fires and burn injuries. The pressure wave can cause permanent hearing damage such as eardrum rupture⁹ at several meters from the detonation site. At distances of up to several tens of meters, the pressure wave may still cause other forms of (temporary) hearing damage. The occurrence and severity of hearing damage depend on environmental factors and the condition of the individuals affected.¹⁰

In addition to the injuries caused by the pressure wave and heat of the explosion, injuries may also result from the impact of fragments and shards. At relatively short distances, hot fragments of cardboard, plastic, and—if present—clay from the Super COBRA 6 (2G) itself can cause skin injuries. If the Super COBRA 6 (2G) damages a nearby object, fragments and shards from that object

⁷ Dangers are only described in broad terms in this factsheet given that a specific description of the location where the explosion occurs is not provided. Objects present at a location can contribute to more or less danger for bystanders. The position of a person's body is not taken into account either (upright or squatting, for instance), nor the height at which the explosive device detonates, in relation to that person (at eye or on the ground, for example). The number and the position of bystanders at a location also play a role in assessing the dangers. Generally, more tests must be performed in order to precisely determine the dangers for one specifically described scenario.

⁸ The Explosives and Explosions department at the NFI uses the following series for the level of injury (in ascending order):
• Physical injury: minor injuries requiring doctor's treatment and/or reversible injuries (ears – no deafness, eyes – no blindness).

- Severe physical injury: irreversible injuries (in the case of ears – deafness, eyes – blindness) or injuries which will have serious consequences if untreated.
- Very severe physical injury: permanent disfigurements which could lead to death, if untreated.
- Fatal injury: injury which results in almost instantaneous death.
- Fatal injury: injury that leads to death almost immediately.

⁹ TNO report: TNO 2017 R10577 | 2, Study on the impact of illegal fireworks. Commissioned by: Police, National Police Staff, Operations Directorate, The Hague.

¹⁰ Entitlement eligibility guidelines, hearing loss, MPC 00646, ICD-9 389.1 (Sensorineural Hearing Loss), 389.0 (Conductive Hearing Loss), veterans affairs Canada, April 2006.

may be propelled away from the explosion at high speed. If these fragments are made of hard materials such as glass, metal, or stone, they can cause physical injuries. The severity of such injuries depends on the shape, weight, and velocity of the fragment or shard. The likelihood of being struck is directly related to the number of fragments released during the explosion and can vary significantly depending on the specific local conditions.

Examples of Super COBRA 6 victims with severe injuries

In the past, individuals have lost limbs, eyes, or their hearing as a result of direct contact with a Super COBRA 6 (2G). In most cases, these were people who ignited the COBRA 6 themselves, but in some cases, bystanders were affected. Since 2020, there have been at least three incidents (based on NFI case files) where an ignited Super COBRA 6 was thrown through a mailbox or window into a residence, resulting in serious injury to a resident. These residents approached the device without realizing it was an ignited Super COBRA 6. Serious injuries to limbs and eyes, as well as permanent hearing loss caused by a detonating Super COBRA 6 (2G), are therefore not hypothetical—they occur in practice.

In scenarios where a Super COBRA 6 (2G) is thrown at professional emergency responders or law enforcement officers, the above-mentioned danger applies in cases where they are not wearing protective clothing or hearing protection and/or are struck on an unprotected part of the body. The NFI cannot make any general statements about the effect of a detonating Super COBRA 6 (2G) on a person wearing protective clothing without conducting further research. This is due to the wide variation in the properties of protective gear. However, previous research by TNO has shown that the explosion of a Super COBRA 6 can, in some cases, tear holes in protective clothing and thereby cause injury.⁸

Specifically for situations in which a Super COBRA 6 detonates against a glass window, the NFI has conducted practical tests. In the case of double and triple glazing, the explosion of a Super COBRA 6 causes such severe fragmentation of the glass directly behind it that a kind of "sandblast" of fine glass particles is ejected (see photos 11 through 13), in addition to the dangers already described. The exact effect of this on the human body is not yet known, but it is plausible that anyone struck by it could sustain serious physical injury. During the experiments, it was observed that fire effects from the explosion occurred on both sides of the window (see photo 12). The pressure wave from the explosion was also recorded on both sides of the glass.

As explained at the beginning of this section, the danger posed by an exploding Super COBRA 6 (2G) depends on many factors. If this factsheet does not provide sufficient insight into the danger in a specific case, it is advisable to contact your forensic explosives expert. This also applies in cases involving more than one Super COBRA 6 (2G) (see also §4.2), or when modifications have been made to

the Super COBRA 6 (2G) (such as the addition of an aerosol can, nails, a bottle of petrol, etc.).

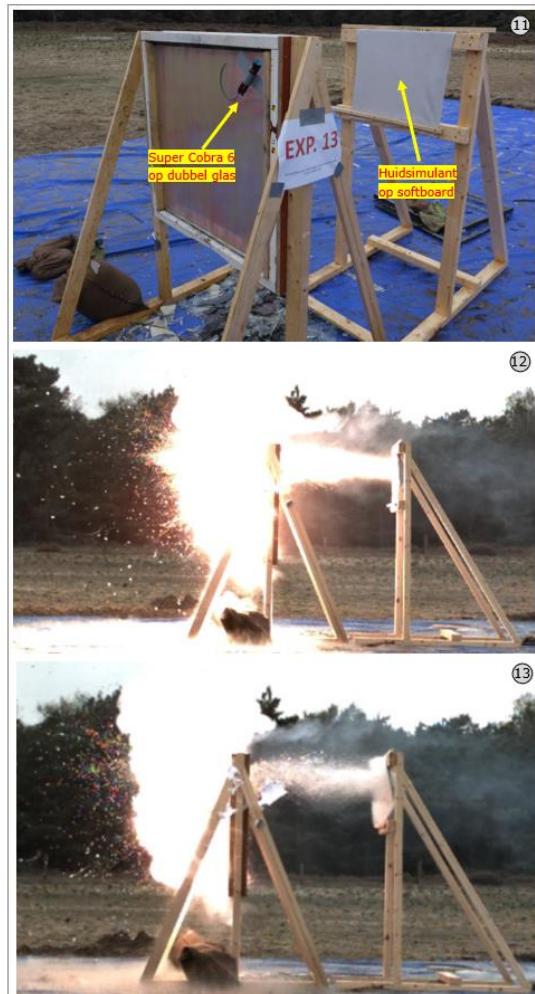


Photo 11. Initial setup of the test: Super COBRA 6 placed in the corner of a double-glazed window in a wooden frame. A second wooden frame contains a skin simulant.

Photos 12 and 13. Effect of the Super COBRA 6 explosion, recorded with a high-speed camera. Photo 12 shows the fire effects. Photo 13 shows the "sandblast" of glass particles striking a softboard with a skin simulant at a distance of 1 meter.



For general questions, you can contact the NFI by phone +31 (70) 888 68 88.

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