

What is an Explosive?



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(Explosives)**

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 - Historical point of view
 - Key explosive legislation
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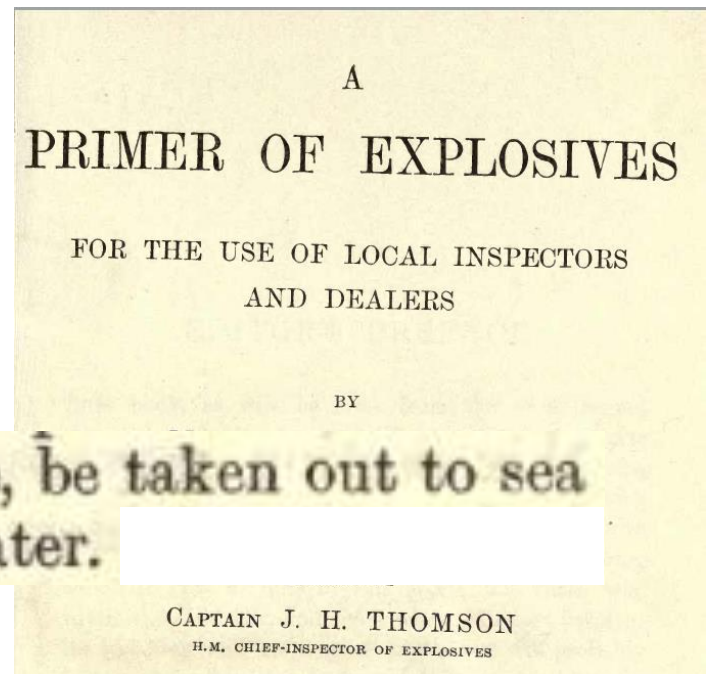
What is an Explosive?

Why is this question important?

- Understanding the scope and application of legislation
- Understanding the inherent properties of explosive substances/articles that are:
 - Manufactured
 - Used in manufacture
 - Stored
 - Transported

What is an Explosive?

- Combustion
- Effect of Confinement
- Detonation



Detonators should, if practicable, be taken out to sea and thrown overboard in deep water.

- Essentials of an Explosive
- Properties of a Good Explosive
- Choice of a Good Explosive
- An Explosive within the Meaning of the Act

Key Explosives Legislation

- Manufacture and Storage

The Explosive Act 1875



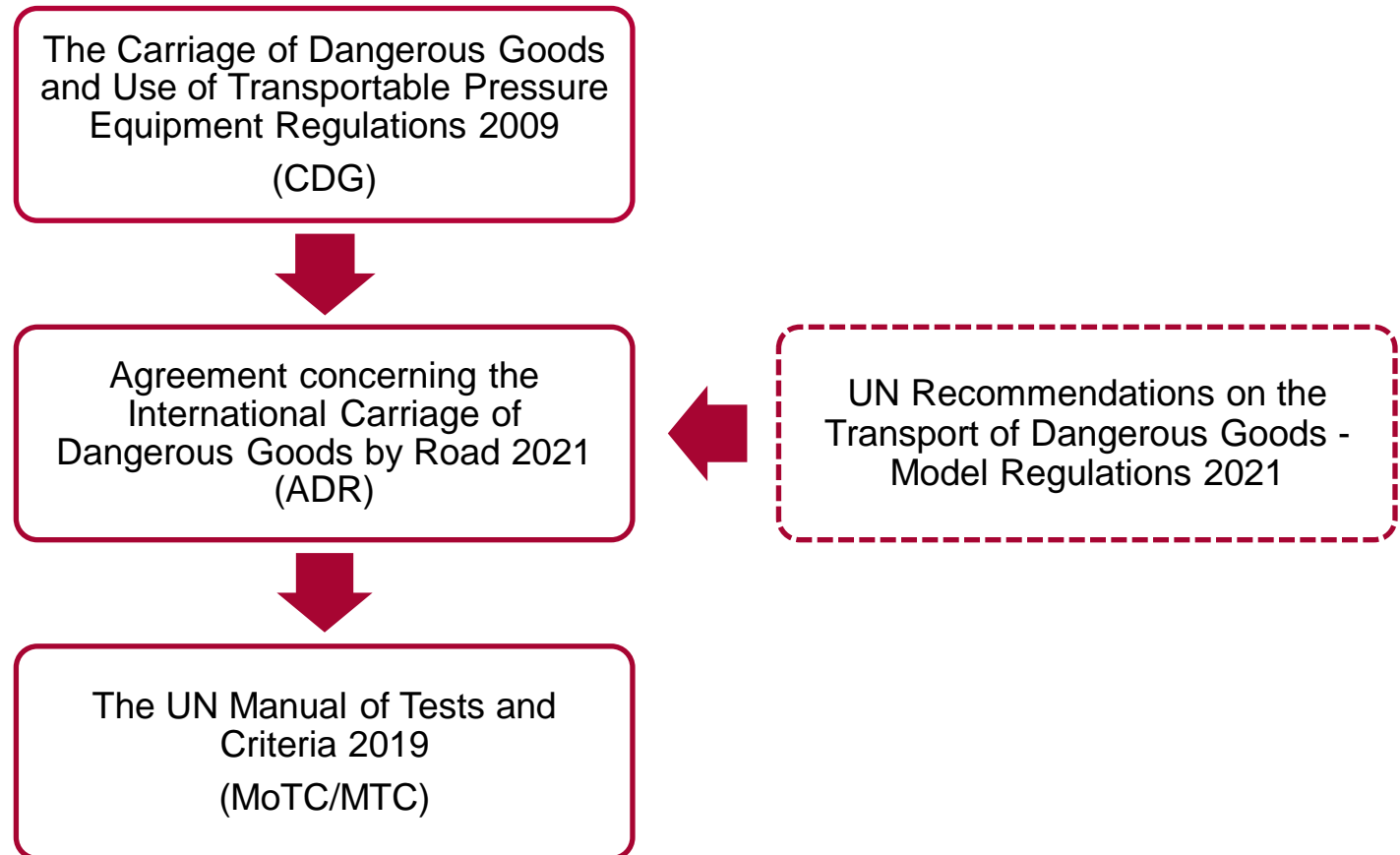
The Manufacture and Storage
of Explosives Regulations 2005
(MSER)



The Explosive Regulations
2014
(ER2014)

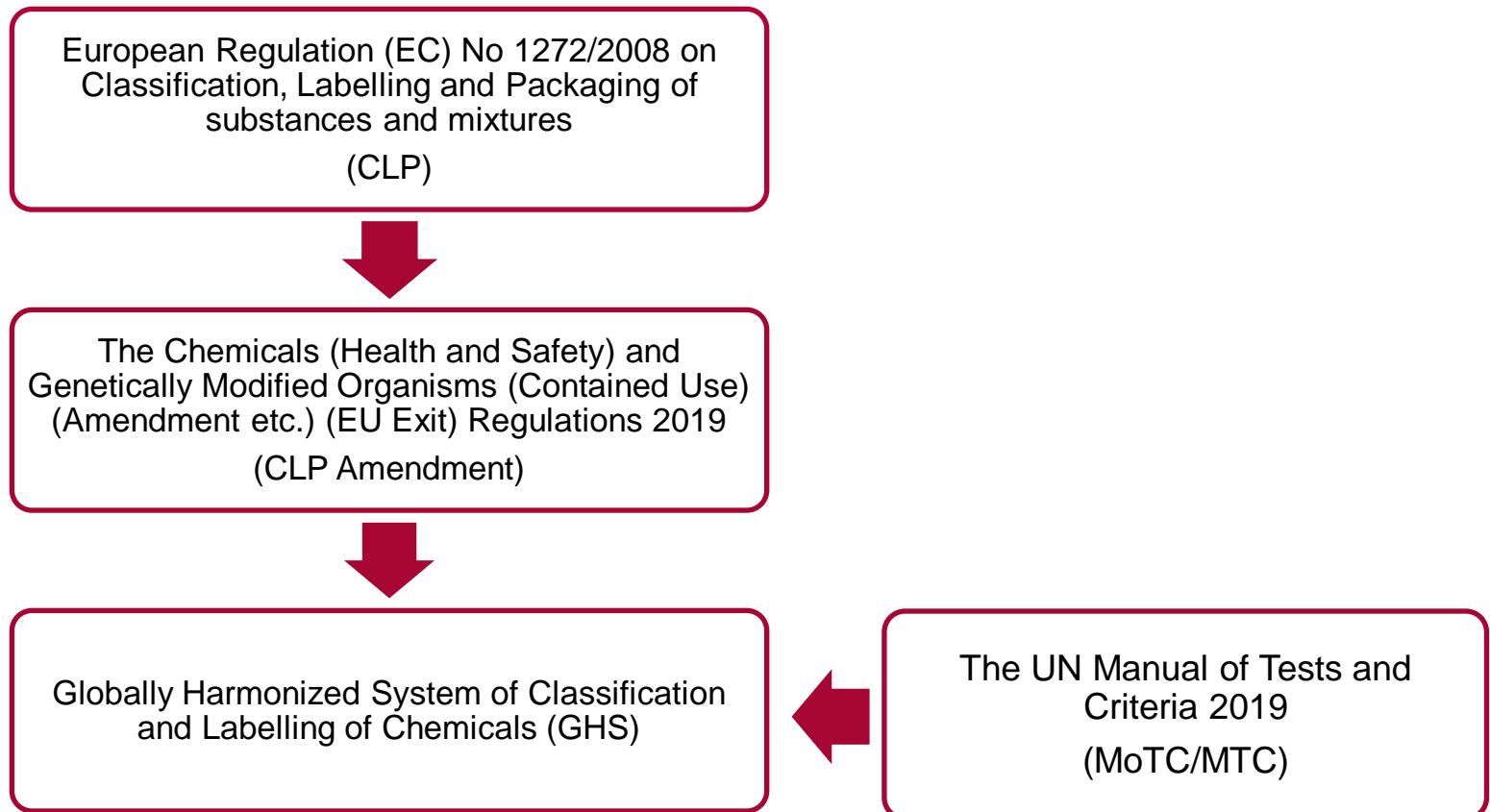
Key Explosives Legislation

- Transport



Key Explosives Legislation

- Classification, Labelling and Packaging



What is an Explosive?

- **The Explosive Act 1875**

Substances to which this Act applies.

This Act shall apply to gunpowder and other explosives as defined by this section.

The term “explosive” in this Act—

(1) Means gunpowder, nitro–glycerine, dynamite, gun–cotton, blasting powders, fulminate of mercury or of other metals, coloured fires, and every other substance, whether similar to those above–mentioned or not, used or manufactured **with a view to produce a practical effect by explosion or a pyrotechnic effect**; and

(2) Includes fog–signals, fireworks, fuzes, rockets, percussion caps, detonators, cartridges, ammunition of all descriptions, and every adaptation or preparation of an explosive as above defined.

ER2014 - What is an Explosive?

“explosive” means —

(a) any explosive article or explosive substance which would —

- (i) if packaged for transport, be classified in accordance with the United Nations Recommendations as falling within Class 1; or
- (ii) be classified in accordance with the United Nations Recommendations as —
 - (aa) being unduly sensitive or so reactive as to be subject to spontaneous reaction and accordingly too dangerous to transport, and
 - (bb) falling within Class 1; or

(b) a desensitised explosive,

but it does not include an explosive substance produced as part of a manufacturing process which thereafter reprocesses it in order to produce a substance or preparation which is not an explosive substance;

ER2014 - What is an Explosive?

“desensitised explosive” means —

(a) a solid explosive substance which has been wetted with water or alcohol or diluted with one or more other substances; or

(b) a liquid explosive substance which has been dissolved or suspended in water or one or more other substances, to form a homogeneous mixture so as to suppress its explosive properties and which, without that treatment, would be classified in accordance with the United Nations Recommendations as falling within Class 1;

ER2014 – Explosive Substances/Articles



- “explosive substance” means a substance or preparation, not including a substance or preparation in a solely gaseous form or in the form of vapour, which is —
 - (a) capable by chemical reaction in itself of producing gas at such a temperature and pressure and at such a speed as could cause damage to surroundings; or
 - (b) designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these as a result of a non-detonative, self-sustaining, exothermic chemical reaction;
- “explosive article” means an article containing one or more explosive substances

ADR 2021 - What is an Explosive?

2.2.1.1.1 The heading of Class 1 covers:

- (a) Explosive substances: solid or liquid substances (or mixtures of substances) capable by chemical reaction of producing gases at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

Capable by **chemical reaction** of producing **gases** at such a **temperature** and **pressure** and at such as **speed** to cause **damage** to the **surroundings**

Substances and Articles not mentioned above which are manufactured with a view to producing a **practical** explosive or pyrotechnic effect

Phlegmatized means that a substance (or "phlegmatizer") has been added to an explosive to enhance its safety in handling and carriage. The phlegmatizer renders the explosive insensitive, or less sensitive, to the following actions: heat, shock, impact, percussion or friction. Typical phlegmatizing agents include, but are not limited to: wax, paper, water, polymers (such as chlorofluoropolymers), alcohol and oils (such as petroleum jelly and paraffin).

UN Manual of Tests and Criteria



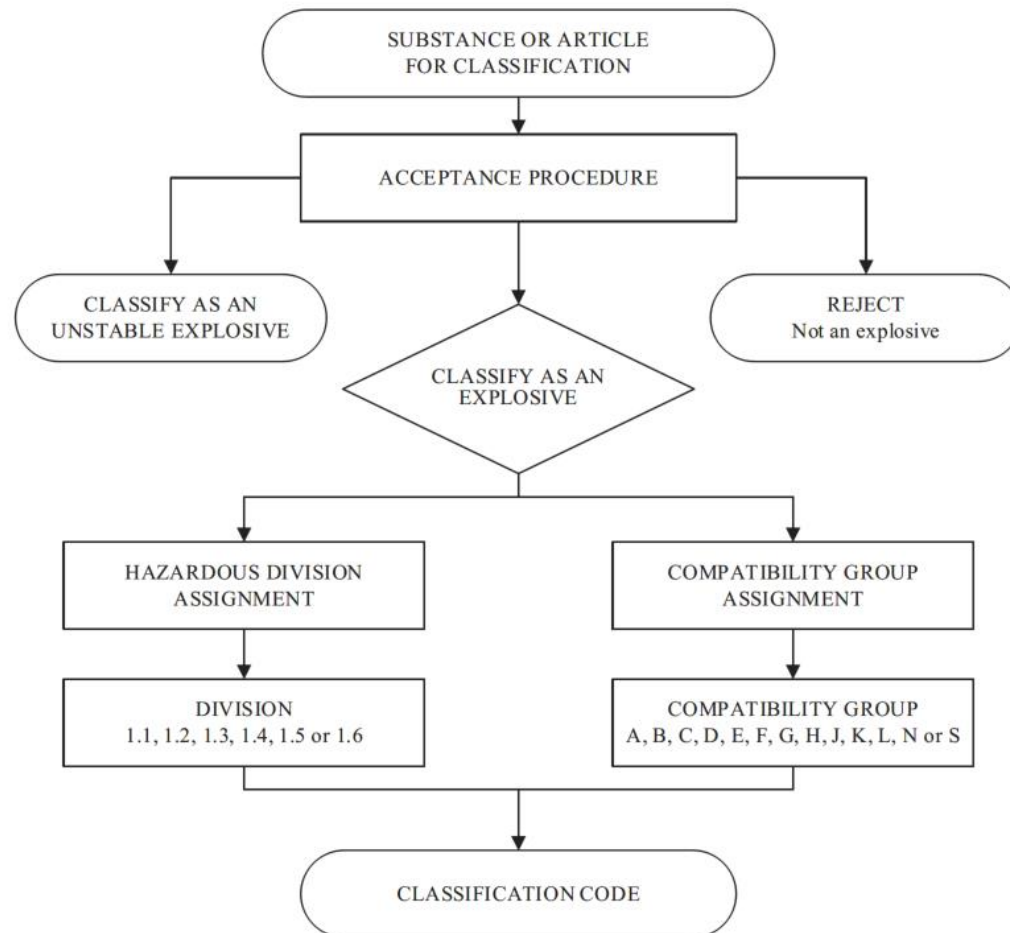
- When should you test?

10.2.1 New products which are considered as having **explosive properties** or are **intended to function as explosives** should first be considered for inclusion in the class of explosives. In this context a new product is one which, when appropriate in the opinion of the competent authority, involves any of the following:

- (a) A new substance, intended to function as an explosive or pyrotechnic, which is considered to be significantly different from other substances already classified;
- (b) A new substance or article, not intended for explosive use, which has, or is suspected of having, explosive properties;
- (c) A new design of article containing an explosive substance or an article containing a new explosive substance; or
- (d) A new design of package for an explosive substance or article including a new type of inner packaging or a new arrangement of articles (a relatively minor change to an inner or outer packaging can be critical and can convert a lesser hazard into a mass explosion hazard).

UN Manual of Tests and Criteria

Figure 10.1: Overall scheme of the procedure for classifying a substance or article in the class of explosives



UN Manual of Tests and Criteria - Explosive Substances



- **Test Series 1 - Is it an explosive substance?**
- **Test Series 2 - Is the substance too insensitive for inclusion in the class of explosives?**
 - UN gap Test
 - Koenen Test
 - Time/Pressure Test or Internal Ignition Test
- **Test Series 3 – stable explosive?**
 - Type 3 (a): sensitiveness to impact
 - Type 3 (b): sensitiveness to friction
 - Type 3 (c): thermal stability of a substance
 - Type 3 (d): the response of the substance to fire.
- **Test Series 4 – Safe to transport?**
 - Thermal stability
 - 12 metre drop test
- **Test Series 6 – Hazard Division?**
 - 6(a), 6(b), 6(c) & 6(d)

UN Manual of Tests and Criteria - Explosive Articles – as packaged for transport



- **Test Series 4 – Safe to transport**
 - Thermal stability
 - 12 metre drop test
- **Test Series 6 – Hazard Division**
 - Type 6 (a): single package to determine if there is mass explosion of the contents – **HD 1.1**
 - Type 6 (b): packages of an explosive substance or explosive articles, or nonpackaged – **HD 1.1**
 - Type 6 (c): packages of an explosive substance or explosive articles, or nonpackaged – **HD 1.1/1.2/1.3/1.4 and 1.4S**
 - Type 6 (d): unconfined package of explosive articles to which special provision 347 of Chapter 3.3 of the Model Regulations applies – **HD 1.4S**
- Test Series 3 is not directly required but we usually require the information/technical justification for the compositions to be presented

6(a) – Safety concern, was classified at 1.4S





6(c)



6(c) - 9mm ammunition



Series 6(d)



2.1.1.1 *Definitions*

An *explosive substance or mixture* is a solid or liquid substance or mixture which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances and mixtures are included even when they do not evolve gases.

A *pyrotechnic substance or mixture* is a substance or mixture designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reactions.

An *explosive article* is an article containing one or more explosive substances or mixtures.

Division means the classification of an explosive substance, mixture or article according to Part I of the Manual of Tests and Criteria and relates to it being in a certain configuration.

Primary packaging means the minimum level of packaging of a configuration assigned a division, in which the explosive substance, mixture or article is intended to be retained until use.

NOTE: *Divisions are generally assigned for the purpose of transport and may be subject to further packaging specifications according to the UN Model Regulations to be valid.*

2.1.1.2.2 The following substances and mixtures are excluded from the class of explosives:

(c) *Substances and mixtures which have **not** been manufactured with the view to producing, in themselves, an explosive or pyrotechnic effect...*

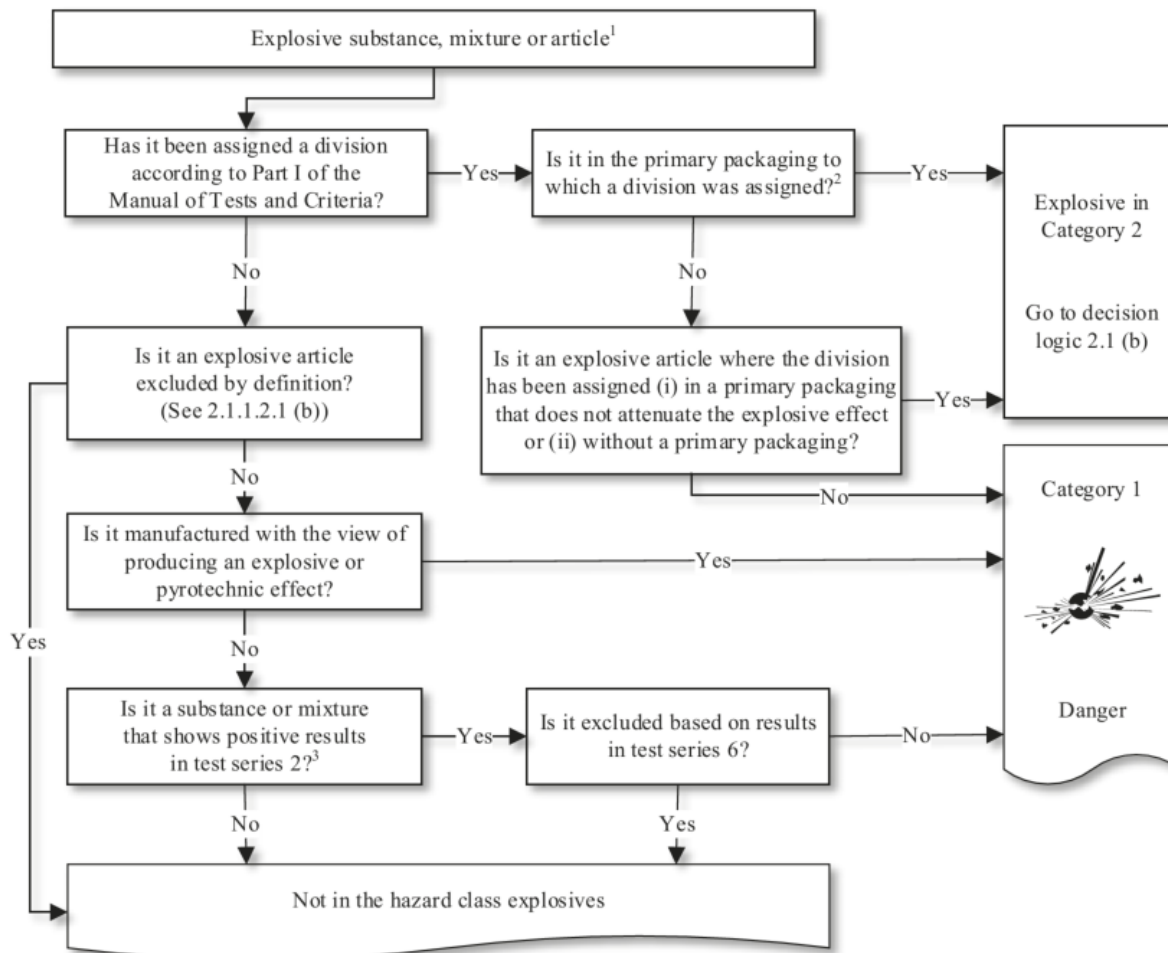


Table 2.1.2: Label elements for explosives

| Category | 1 | 2 | | |
|-----------------------------|---|-----------------------|---------------------------|---------------------------|
| Sub-category | <i>Not applicable</i> | 2A | 2B | 2C |
| Symbol ^a | Exploding bomb | Exploding bomb | Exploding bomb | Exclamation mark |
| Signal word | Danger | Danger | Warning | Warning |
| Hazard statement | Explosive | Explosive | Fire or projection hazard | Fire or projection hazard |
| Additional hazard statement | Very sensitive ^b <i>or</i> May be sensitive ^c | <i>Not applicable</i> | <i>Not applicable</i> | <i>Not applicable</i> |

^a For Divisions 1.4, 1.5 and 1.6 no symbol appears on the label for transport, according to the UN Model Regulations.

^b To be assigned additionally to explosives that are sensitive to initiation as determined by test series 3 or 4 of the Manual of Tests and Criteria. May also be applied to explosives sensitive to other stimuli, e.g. electrostatic discharge.

^c To be assigned additionally to explosives for which sufficient information on their sensitivity to initiation is not available.

Thermite/Thermates

- Thermite – Generic term used for a mixture of a metal which forms a stable oxide of another metal, for example:



- Thermate – a Thermite which is added to a metal nitrate to reduce the temperature of ignition and make ignition easier, for example Incendiary Composition SR306:

| | |
|---------------------------|----|
| aluminium powder (blown) | 10 |
| aluminium powder (flake) | 10 |
| hammerscale (Fe_3O_4) | 40 |
| barium nitrate | 35 |
| boric acid | 5 |

Are Thermite/Thermates Explosives?



- Example - PLASMA 4TH®

Disclaimer Note:

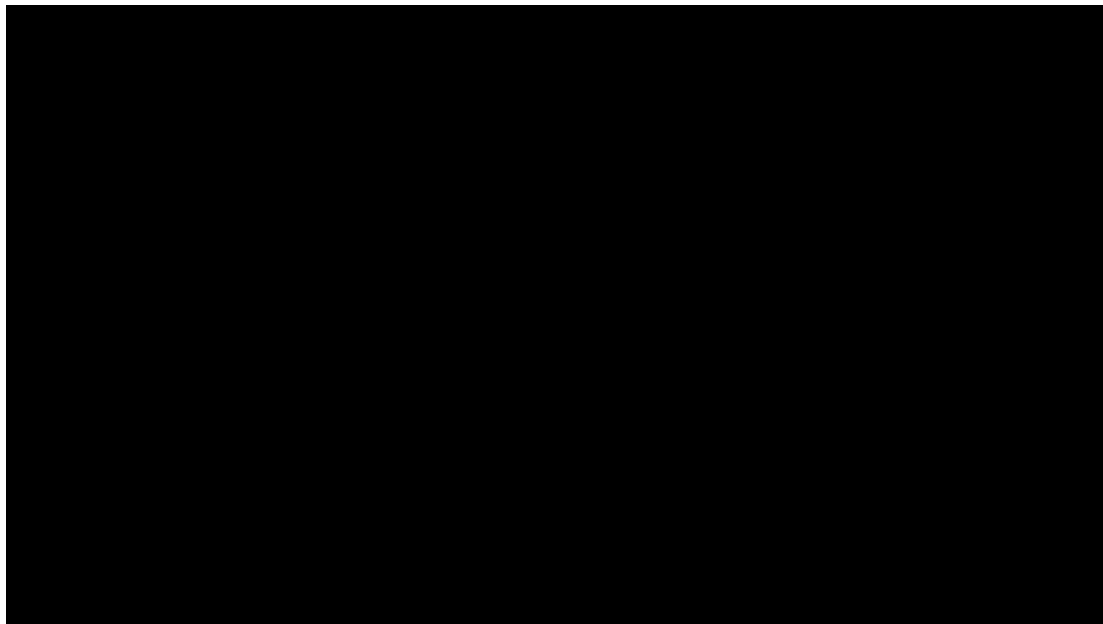
This is an example that was raised by France at the UN Transport of Dangerous Goods Explosive Working Group 2021 meeting.

The reason for inclusion here is to illustrate the current issue with the correct classification of Thermite/Thermates, but **please note HSE is not commenting on this specific product.**

Are Thermite/Thermates Explosives?



- Example - PLASMA 4TH®



Are Thermite/Thermates Explosives?



- Example - [PLASMA 4TH®](#)
- Plasma 4TH sparked a revolution in safe and sustainable **rock breaking** when it first released one of the world's best non-explosive technologies.
- Plasma 4TH® of Enaex group corresponds to a mixture of **salts** and fast-expanding **metallic powders without explosive components**, resulting in a product with innovative characteristics compared to conventional rock fracture, removing 15,000 m³ per shot.

Are Thermite/Thermates Explosives?



- Baxendale's Razor

What are you going to use it for??

- Explosive Substance/Article

Is the substance/article manufactured with the view to producing a practical explosive or pyrotechnic effect?

- Relevent Legislation and Provisions

- ER2014 – Manufacture and Storage
- ADR 2021 – Transport
- MoTC – Transport
- GHS – CLP

Update on HSE Classification Process



HSE has now introduced business assurance checks on our classification process.

The following information is checked on a random sample quarterly by the Chief Inspector of Explosives

- HSE have established ‘safety to transport’, this includes if the explosive is stable.
 - **This relates to Test Series 3 and 4**
- HSE have established ‘correct hazard classification’, this includes that the correct Hazard Division and Compatability Group has been identified.
 - **This relates to Test Series 6**

Further Information

- Explosive Enquires

explosive.enquiries@hse.gov.uk

- CAD Enquiries

Cad.Explosives@hse.gov.uk

- Web site

<https://www.hse.gov.uk/explosives/classification/index.htm>

Questions?



CLASS V.—FULMINATE

Definition of a Fulminate.—*The term “fulminate” means any chemical compound or mechanical mixture, whether included in the foregoing classes or not, which, from its great susceptibility to detonation, is suitable for employment in percussion-caps or any other appliances for developing detonation, or which, from its extreme sensibility to explosion, and from its great instability (that is to say, readiness to undergo decomposition from very slight exciting causes), is especially dangerous.*

This class consists of two divisions.

Division I

This division comprises such compounds as the fulminates of silver and of mercury, and preparations of these substances, such as are used in percussion-caps, and any preparation consisting of a mixture of a chlorate with phosphorus, or certain descriptions of phosphorous compounds, with or without the addition of carbonaceous matter, and any preparation consisting of a mixture of a chlorate with sulphur, or with a sulphuret, with or without carbonaceous matter

Division II

This division comprises such substances as the chloride and the iodide of nitrogen, fulminating gold and silver, diazo-benzol, and the nitrate of diazo-benzol.