International Journal of Scientific Research and Engineering Development-– Volume 4 Issue 1, Jan-Feb 2021

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Forensic Engineering Investigation on Handling Explosive in India

Subhajit Dutta Gupta

Batchelor of Technology in Mechanical Engineering, PG Diploma in Industrial Safety Management &PG Certification in Forensic Engineering.

----------**********----------

Abstract:

This paper will indicate how to handle explosivebeen a forensic engineering investigator in India. It will also give a brief explanation on rules and regulation, basic parameters and device initiation.

Keywords **—The Explosive Rules2008, Classification of Explosive, Properties of Explosives, Initiating Devices, Deflagrations and detonations, Basic Parameters**

----------**********----------

I. INTRODUCTION

Explosion – A sudden, violent release of energy, it is generally accompanied by a loud noise and expanding pressure of wave and gas, the pressure of gas therefore decreases with distance from the origin or epicentre. Explosion caused by the sudden release of chemical energy are classified into two main types:

- Deflagrating explosions
- Detonating explosions

Deflagrating explosion generally cause damage by pushing things around because of pressure differentials, this includes things like walls, ceilings, floors, large pieces of furniture, etc.

Deflagrations generally have a low ability to cause fissile-or brisance type damages. Small objects near the epicentre of the deflagration are often left undamaged as the pressure wave passes around them, the pressure differences on their external surfaces are often insufficient to cause breakage or disintegration.

II. THE EXPLOSIVE RULES, 2008

This act was formed by Government of Indian for the promotion of Industry and Internal Trade under Ministry of Commerce and Industry to administrate section 18 of Explosive Act 1884 (4 of 1884) to control import, export, storage and usage of explosive materials, flammable materials, pressure vessels, design and installations of all necessary and relevant infrastructure.Now, therefore, in exercise of powers conferred by Sections 5 and 7 of the Explosives Act, 1884 (4 of 1884) and in supersession of the Explosives Rules, 1983, except as respect of things done or omitted to be done before such supersession, the Central Government hereby makes following rules, namely "The Explosive Rules, 2008 which contains as follows –

- Chapter 1 – Preliminary
- Chapter II – Classification, Categorisation and Authorisation
- Chapter III – General Provisions
- Chapter IV – Special Provisions For Manufacture of Explosive
- Chapter V – Special Provisions for Import or Export of Explosives General
- Chapter VI – Special Provisions for Transportation of Explosives General
- Chapter VII – Special Provision for Possession, Sale and Use of Explosives
- Chapter VIII – Grant or Refusal of Approval, No Objection Certificate, Licence, Certificate, Amendment, Transfer and Renewal
- Chapter IX – Power Vested With Authorities

- Chapter X – Accidents, Enquiries And Reports
- Chapter XI – Administrative And Penal Actions

III. CLASSIFICATION OF EXPLOSIVES

Explosives are divided in 8 classes: - (Table 1.1)

Class	Explosives	Definitions
1	Gunpowder	Mixture of Saltpetre, Sulphur, & Charcoal
2	Nitrate-Mixture	Any preparation, other than gunpowder which is formed by the mechanical mixture of a nitrate with any form of carbon
3	Nitro – Compound	Any chemical compound which is possessed of explosive properties or is capable of combining with metals to form an explosive compound, and is produced by the chemical action of nitric acid
4	Chlorate Mixture	Any explosive containing a chlorate.
5	Fulminate	Any chemical compound or mechanical mixture whatever, which from its great susceptibility to detonation.
6	Ammunition	An explosive of any of the foregoing classes when the same is enclosed in any case or contrivance, or is otherwise adapted or prepared so as to forma cartridge.
7	Fireworks	Fireworks composition that is to say, any chemical compound or mechanically mixed preparation of an explosive or inflammable nature, which is used for the purpose of making

		manufactured firework
8	Liquid Oxygen Explosive	Liquid Oxygen Explosives" means an absorbent carbonaceous material such as wood pulp. carbon black, metal powder, coal dust etc. impregnated with liquid air or liquid oxygen with or without the addition of other substances.

(Table 1.1)

IV. PROPERTIES OF EXPLOSIVES

Properties of explosive can help in understanding the performance, predictions that can be made in blast designs. The main properties of explosives are

- Detonation velocity
- Density
- Detonation Pressure
- Water resistance
- Fume class

a. Detonation velocity – It is an important property to consider when rating and explosive, it can be intending as confined or unconfined value which is valued in feet per seconds (FPS), the confined detonation velocity measures the speed at which the detonation waves travel through a column of explosive withing a borehole of a confined surface as well the unconfined velocities indicate this rate when the explosive is detonated in the open. Because explosives generally are used under some degree of confinement, the confined value is more significant.

b. Density – The density of an explosive can be expressed in terms of specific gravity,specific gravity is the ratio of the density of the explosive to the density of water under normal standard conditions.Density is an important consideration when choosing an explosive. For difficult blasting conditions or where fine fragmentation is required, a dense explosiveis usually necessary. In easily fragmented rock or where fine fragmentation is not needed, a low-density explosive will often suffice.

c. Detonation Pressure –It is a function of the detonation velocity and density of an explosive, the detonation pressure of an explosive can be determined when the detonation velocity and specific gravity are known.

d. Water Resistance – Explosive water resistance is a measure of its ability to stand exposure to water without detonating or losing sensitivity, Sensitivity is the point with which explosives detonates. Higher-density explosives have fair to excellent water resistance, whereas low-density explosives and blasting agents have little or none.

e. Fume Class - Ideally, detonation of a commercial explosive produces water vapor, carbon dioxide, and nitrogen. In addition,

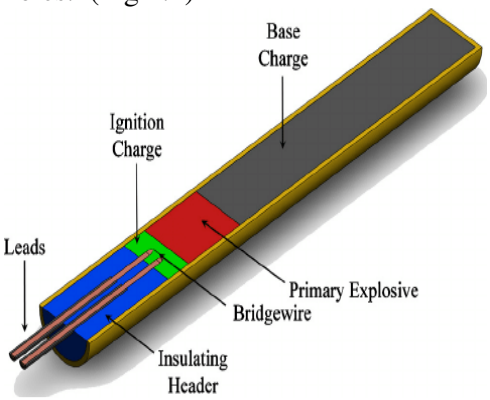
undesirable poisonous gases such as carbon monoxide and nitrogen oxides are usually formed. These gases are known as fumes .

V. INITIATING DEVICES.

The following are the procedure for initiating device: -

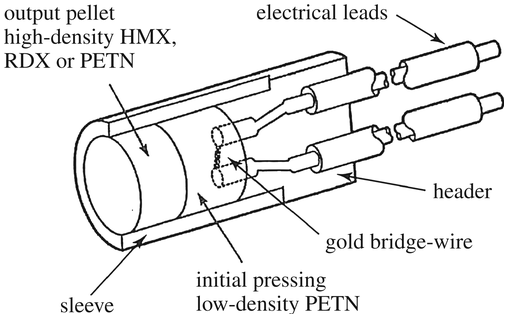
a. Electric Blasting Caps (EBC)
b. Exploding Bridge wire Detonators (EBW)
c. Detonating Cord
d. Nonel Cords and Primadet
e. Primers

- Electric Blasting Caps - The blaster-in-charge must conduct a thorough survey for stray currents and eliminate any dangerous currents before adopting any system of electric firing with electric blasting caps and before loading any holes. (Fig 1.1)



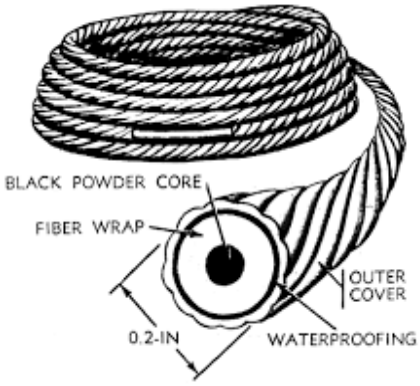
(Fig 1.1)

- Exploding Bridge wire Detonators (EBWs) - Exploding bridgewire detonators (EBWs) are not subject to detonation by static electricity, stray currents, radio transmitters, etc., and may be safely used where these conditions are present. (Fig 1.2)



(Fig 1.2)

- Detonating Cord –It is a thin, flexible plastic tube usually filled with pentaerythritol tetranitrate, Typically, 50-grain down line is used in boreholes. Twenty-five grain down line also works since it is easier to tie and less expensive. (Fig 1.3)

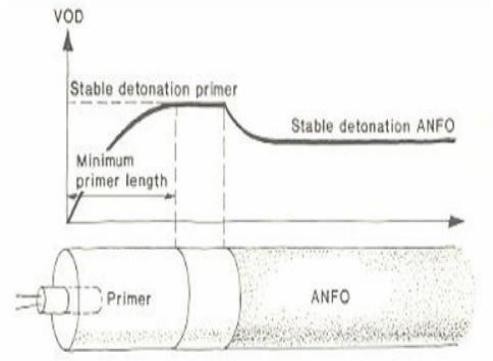


(Fig 1.4)

- Nonel Cords and Primadet - Nonel is a 12-inch diameter plastic tube with a thin reactive coating on the inside surface. When initiated with an EBW, EBC, or detonator cord, the tube transmits a low energy signal from one point to another by means of a shock wave phenomenon similar to a dust explosion.(Fig 1.5)

(Fig 1.5)

- Primers - With non-cap-sensitive blasting agents, the initiation sensitivity is so low that a primer (any cap sensitive explosive) is required to provide adequate initiation for the charge. Primers come in two basic form: cast (often called high-density or HDP primers) for holes of two-inch diameter or more, and Elastomeric (PETN and latex mixes, such as detaprimes) for holes under two inches in diameter. (Fig 1.6)



(Fig 1.6)

VI. DEFLAGRATIONS AND DETONATIONS

Deflagrations often occur when flammable gases or dusts have accumulated to levels above their lower limits of flammability, Examples of deflagrating are:

- Explosive mixtures of natural gas and air at room conditions.
- The decomposition of cellulose nitrate, an unstable compound often used in propellants.
- Black powder
- Grain dust

Detonations are encountered often in arson or sabotage cases. Occasionally, accidental detonations occur, usually in construction work, quarry work, or similar situations. Examples of detonating explosives are:

- Dynamite
- Nitroglycerine
- Mercury fulminate
- Trinitrotoluene (TNT)
- Ammonium nitrate fuel oil (ANFO).

VII. BASIC PARAMETERS

In both deflagrating and detonating explosions, the maximum pressure occurs when the explosion is wholly confined, which is a constant volume process, and the explosive mixture is close to stoichiometric concentrations. The maximum pressure for many hydrocarbon-based deflagrating explosion mixtures will range between seven and nine times the ambient pressure. Below table are the explosive limits of some common gases and metallic dusts. In Table 1.1 and 1.2

Explosive limits of some common Gases

Fuel	Limits (% v/v)
Methane	5.0-15.0
Ethane	3.0-12.4
Propane	2.1-9.5
Acetone	2.6-13.0
Ammonia	15.0-28.0
Gasoline	1.3-6.0
CO	12.5-74.0
Methanol	6.7-12.0

(Table 1.1)

Explosive limits for Metallic dusts

Material	Lower Limit (grams per cubic meter)

Aluminum	80
Iron	120
Magnesium	30
Manganese	120
Sulfur	35
Uranium	60
Zinc	480

VIII. CONCLUSION

From this paper we come to know how to handle explosive, the paper also gave an explanation on explosive rules, classification, properties, initiating and some basic parameters while handling explosive which will help a forensic investigation in their field investigation. In most cases an identification of the explosive material will be determined in conjunction with a known standard (if available). Weight/mass will accompany the identification . it may include explosive materials, common solid combustion products, non-explosive components, and if possible, an estimated weight/mass of pre blast explosive material.

REFERENCES

[1] The explosive rule 2008, http://www.home.mp.gov.in/sites/default/files/2018-03/1501766223-Explosive_Rules_2008.pdf
[2] Randall K. Noon, Forensic Engineering Investigation 1. Title's 0-8493-0911-5 (alk. Paper)
[3] Bridge wire image - https://www.researchgate.net/figure/Color-online-Match-type-electric-blasting-cap-schematic_fig1_47632867
[4] Exploding Bridge wire Detonators - https://royalsocietypublishing.org/doi/10.1098/rspa.2019.0120
[5] Detonating Cord https://en.wikipedia.org/wiki/Detonating_cord
[6] Deflagrations https://www.sciencedirect.com/topics/engineering/deflagration
[7] Parameters - https://www.nps.gov/parkhistory/online_books/npsg/explosives/Chapter6.pdf
[8] Introduction *to Forensic Engineering* (The Forensic Library) by Randall K. Noon, CRC Press (1992)

