

# Status of pollution abatement measures **FIRECRACKERS (patakas)**



**Central Pollution Control Board**

*Ministry of Environment, Forest & Climate Change*

# Status of pollution abatement measures: FIRE-CRACKERS (patakas)



## **CENTRAL POLLUTION CONTROL BOARD**

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CENTRAL POLLUTION CONTROL BOARD  
Ministry of Environment, Forest & Climate Change  
(Government of India)

## Foreword

Bursting firecrackers on festive occasions is not new to any state of the country including their public display. However, health concerns on bursting of firecrackers have frequently been raised not only due to high noise decibels but also due to the undesirable emissions released due to combusive properties of the non – stoichiometric ingredients of firecrackers. In view of the above concerns Hon'ble Supreme Court in the matter of Writ Petition (Civil) No.72/1998 (Noise Pollution), issued directions to all the States and Union Territories on control of noise levels and emissions from bursting of fire-crackers.

Under the Noise Pollution (Regulation and Control) Rules, 2000, firecrackers are recognised as one of the sources contributing to ambient noise in public places and some restrictions on their use have also been laid down. '**Firecrackers (patakas) - Status of pollution abatement measures**' is CPCB's first report containing information on the initiatives taken in compliance of the Hon'ble Supreme Court directions, the role of Bureau of Indian Standards (BIS) in harmonising standards on firecrackers with International Organisation (ISO) and some aspects relating to mass awareness on the subject.

Ambient noise monitoring during Diwali is being conducted in various cities by CPCB and the SPCBs / PCCs every year. CPCB also displays real time noise levels at various locations in seven State capitals under its National Ambient Noise Monitoring Network Programme. It is hoped that this report will be helpful to all stakeholders associated in management & handling of firecrackers and to various academic institutions in carrying out further research on the subject.

  
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October 2017



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# ACKNOWLEDGEMENTS

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## **Noise surveys (manual) in cities during Deepawali / Diwali by CPCB**

Delhi – CPCB HQ Delhi, Air Laboratory,  
Regional Directorates at Lucknow (North)  
Bangalore - Regional Directorates (South)  
Kolkata - Regional Directorates (East)  
Bhopal - Regional Directorates (Central)  
Vadodara - Regional Directorates (West)  
Shillong Regional Directorates (NE)  
Agra - Project Office, Agra

## **CPCB's Real time noise monitoring network data in SEVEN cities in collaboration with SPCBs / PCCs:**

Delhi – CPCB  
For other cities in association with SPCBs / PCC of Andhra Pradesh, Maharashtra, Karnataka, West Bengal, Tamil Nadu, Uttar Pradesh, and Delhi

## **Analyses of ambient air quality including metals / elements during Diwali period (CPCB)**

CPCB Air Laboratory

## **Testing Firecracker samples for noise levels**

National Physical Laboratory, Pusa, Delhi

## **Testing Firecracker samples for chemical composition**

Shriram Institute of Industrial Research (SIIR), Delhi

## **Development of Noise standards for Firecrackers**

CPCB's National Committee on Noise Pollution Control (NCNPC)

## **Firecrackers standards w.r.t. chemical composition**

Petroleum and Explosive Safety Organization (PESO), Nagpur (formerly Department of Explosives)

Report formatted by Shri Prem Raj IT Officer, ENVIS

*Note: All PHOTOGRAPHS have been taken from the internet to highlight impacts on environment due to bursting of firecrackers and related issues*

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## Hon'ble Supreme Court's directions on bursting FIRECRACKERS

### 1.1 Hon'ble Supreme Court's directions (delivered on [27.9.2001](#))

The direction of the Hon'ble Supreme Court in the matter of bursting of firecrackers particularly during Diwali has played an important role in the actions taken by various government departments in addressing pollution from arising from bursting firecrackers. The case goes back to hearing on the matter Writ Petition (Civil) No.72/1998 (Noise Pollution) for restricting use of loudspeakers and high volume producing sound systems) on [27.9.2001](#), issued following directions to all the states and all the Union Territories to control noise pollution arising out of bursting of firecrackers, in view of Dussehra, Diwali and other festivals :

- i. The Union Government, the Union Territories as well as all the State Governments shall take steps to strictly comply with the rules framed under The Environment (Protection) Act, 1986. These Rules related to the noise standards for firecrackers mentioned at Sl. No. 89 of Notification No. GSR 682(E), dated 5.10.1999.
- ii. The use of fireworks or firecrackers shall not be permitted except between 6.00 p.m. and 10.00 p.m.
- iii. No fireworks or firecrackers shall be used between 10.00 p.m. and 6.00 a.m.
- iv. Firecrackers shall not be used at any time in silence zones.
- v. The State Education Resource Centres in all the States and the Union Territories as well as the management/principals of schools in all the States and Union Territories shall take appropriate steps to educate students about the ill effects of air and noise pollution.
- vi. The Hon'ble Court, further directed that these directions shall be given wide publicity both by electronic and print media.

### 1.2 Hon'ble Supreme Court's directions (delivered on [July 18, 2005](#))

The Hon'ble Supreme Court of India has banned the bursting of fire-crackers or any noise generating fireworks of high decibels to control the noise pollution. As per Hon'ble Supreme Court of India, [CWP No. 72 of 1998, final judgment delivered on [July 18, 2005](#)], it has directed the Department of Explosives (DOE) (presently known as Petroleum and Explosives Safety Organisation (PESO)) as under regarding **FIRECRACKERS:**



1. On a comparison of the two systems i.e. the present system of evaluating firecrackers on the basis of noise levels, and the other where the firecrackers shall be evaluated on the basis of chemical composition, we feel that the latter method is more practical and workable in Indian circumstances. It shall be followed unless and until replaced by a better system.
2. The Department of Explosives (DOE) shall undertake necessary research activity for the purpose and come out with the chemical formulae for each type or category or class of firecrackers. DOE shall specify the proportion/composition as well as the maximum permissible weight of every chemical used in manufacturing firecrackers.
3. The Department of Explosives may divide the firecrackers into two categories - (i) sound-emitting firecrackers, and (ii) colour/light- emitting firecrackers. There shall be a complete ban on bursting sound-emitting firecrackers between 10 p.m. and 6 a.m. It is not necessary to impose restrictions as to time on bursting of colour/light-emitting firecrackers.
4. Every manufacturer shall on the box of each firecracker mention details of its chemical contents and that it satisfies the requirement as laid down by DOE. In case of a failure on the part of the manufacturer to mention the details or in cases where the contents of the box do not match the chemical formulae as stated on the box, the manufacturer may be held liable.
5. Firecrackers for the purpose of export may be manufactured bearing higher noise levels subject to the following conditions: (i) the manufacturer should be permitted to do so only when he has an export order with him and not otherwise; (ii) the noise levels for these firecrackers should conform to the noise standards prescribed in the country to which they are intended to be exported as per the export order; (iii) these firecrackers should have a different colour packing, from those intended to be sold in India; (iv) they must carry a declaration printed thereon something like “not for sale in India” or “only for export to country AB” and so on.

The noise level standards are also prescribed for firecrackers at manufacturing stage to control the ambient noise pollution. These shall be applicable at the manufacturing stage which is to be ensured by Petroleum and Explosive Safety Organisation (PESO); formerly Dept. of Explosives is the implementing agency.

### **1.3 Hon'ble Supreme Court's directions (delivered on [11<sup>th</sup> November 2016](#))**

In the matter before Hon'ble Supreme Court Arjun Gopal & Others Vs. UoI; CPCB is respondent no. #2 ; The other respondents are: MoEF&CC, DPCC, Delhi Police Licensing Unit, Chief Controller of Explosives – PESO.

Hon'ble SC's direction to CPCB:

As per directions ‘In addition to the above we direct CPCB to study and prepare a report on the harmful effects of the materials which are currently being used in the manufacture of fireworks’.

#### **1.4 Primary areas of focus on firecrackers by Hon’ble Supreme Court**

Based on the above, the Hon’ble Supreme Court of India has highlighted the two ways for assessment of firecrackers:

- a) evaluating fire-crackers on the basis of noise levels
- b) evaluating fire-crackers on the basis of chemical composition.

#### **1.5 Objectives & scope of report**

The objectives of the report:

- i. To highlight the status of pollution abatement measures w.r.t. sound emitting firecrackers
- ii. To highlight the status of pollution abatement measures w.r.t. light emitting firecrackers
- iii. Challenges & way forward

The presentation shall be discussed within the scope under Noise (Regulation & Control) Rules 2000 and Explosives Rules 2008

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### ‘NOISE’ recognized as a ‘pollutant’

#### 2.1 Air (Prevention and Control of Pollution) Act, 1981

Under section 2(a) of Air (Prevention and Control of Pollution) Act, 1981 **noise is defined as ‘air pollutant’**. “Air pollutant” means any solid, liquid or gaseous substance [(including **NOISE**)] present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.”

#### 2.2 National Environment Policy (NEP) 2006

National Environment Policy was approved by the Union Cabinet on 18<sup>th</sup> May, 2006

- a. Regarding, ‘Noise pollution’ the NEP mentions: *‘Persistent exposure to elevated noise levels has been established to result in significant adverse health impacts. At the same time, it needs to be understood that certain environments in which people choose to live and work necessarily involve a certain level of noise.’*
- b. NEP also suggests that abatement of noise pollution to be also considered in urban planning as follows: *‘Include ambient noise as among the environmental quality parameters to be routinely monitored in specified urban areas.’*

#### 2.3 Restrictions on bursting firecrackers under Noise Pollution (Regulation and Control) Rules, 2000

The Central Government notified the Noise Pollution (Regulation and Control) Rules, 2000, vide S.O 123(E) dated 14.2.2000, under the Environment (Protection) Act, 1986. Ambient Air Quality Standards w.r.t. NOISE was notified under Noise Pollution (Regulation and Control) Rules, 2000. The Rules were last amended in January 2010 to reduce noise levels at night (by restricting the use of horns, sound emitting construction equipment’s and **bursting of fire crackers**).

**Table 2.1: Ambient Air Quality Standards w.r.t. NOISE**

Area code	Zones	Day Time dB(A) Leq	Night Time dB(A) Leq	1) <u>Day time</u> : 6.00 a.m. to 10.00 p.m. (16 hours) 2) <u>Night time</u> 10.00 p.m. to 6.00 a.m. (8 hours)
A	Industrial	75	70	
B	Commercial	65	55	
C	Residential	55	45	
D	Silence	50	40	

- a) The Noise Pollution (Regulation and Control) Rules, 2000 highlights major sources of noise contributing to ambient noise in public places ex. industrial activity, construction activity, **firecrackers**, sound producing instruments, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices.
- b) Regarding type of firecracker , the Noise Pollution (Regulation and Control) Rules , 2000 mentions that ‘bursting firecracker’ apply to ‘sound caused by bursting of sound emitting fire crackers’
- c) Rule 5A and Rule 8 (1) (a) (iii) under Noise Pollution (Regulation and Control) Rules, 2000 provides for restrictions on bursting of firecrackers.
- d) Rule 5A (sub-rule 2) under the Noise Pollution (Regulation and Control) Rules, 2000 on ‘Restrictions on the bursting of fire crackers: Sound emitting fire crackers shall not be burst in silence zone or during night time’.
- e) Ban of bursting firecrackers in silence zone: Under the Noise Pollution (Regulation and Control) Rules, 2000 ‘silence zone’ (see rule 3(1) and 4(1)) defined as *An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared as silence area / zone for the purpose of these rules.*



Delhi Govt. vide order dated 3<sup>rd</sup> April 2008 defined ‘silence zone’ as:

- area of 100 m around educational institutions having more than 1000 students
- an area of 100 metres around 100 bed hospitals & above
- an area of 100 metres around all courts
- an area of 100 metres around all Government Office Complexes

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## Firecrackers – Accidents & Health concerns

### 3.1 Fireworks associated with celebrations

There are several occasions to burst fireworks the key ones are :

- a) Bursting of fireworks is done on special occasions like social gatherings, marriages, Diwali/Deepawali, Dusshera, Independence Day, Republic day, New Year etc. Across the country this celebration is mainly observed on two major occasions – during Dusshera and Diwali/Deepawali. It is reported that nearly 80 percent of the firecrackers in the entire nation are sold during the month of Diwali/Deepawali.
- b) 'Public display' of fireworks: Among all the states the 'public display' of fireworks is more frequent in Kerala during temples festivals and during 'Pooram' a Hindu ritual festival. There are many other festivals that celebrated ex. Thrissur Pooram, Nenmara Vallangi Vela, Arattupuzha Pooram, Chinakkathoor Pooram etc. The most spectacular show during the 'Pooram' is the magnificent and thunderous display of fireworks the fireworks display is unique to Kerala temple festivals, generally marks the grand finale of the festival.

### 3.2 Sivakasi - fireworks capital of India

India is the second biggest producer of fireworks after China, almost all of it is for domestic consumption. The country's firecracker industry (a hazardous industry) boasts of an estimated annual turnover of more than \$365m (£225m).

Sivakasi, Virudhunagar district in Tamil Nadu in south, is considered the "fireworks capital" of India, it is one of the biggest centers for the manufacture of matches and fire crackers in India. It has been reported that the town produces more than 90% of India's fireworks. Almost all people in Sivakasi are directly or indirectly engaged in trade of fireworks and crackers includes safety matches. Safety matches sector is slowly getting phased out due mechanization in lighting methods ex. Lighters.

Besides Tamil Nadu firecrackers are also manufactured in the other ex. Kerala and West Bengal.

### 3.3 Accidents caused due to firecrackers

Fireworks industry is a hazardous industry, from the place of manufacture, transportation and storage of fireworks is a risk to life and property. Non – stoichiometric proportions of ingredients in firecrackers cause accidents. Accidents from firecrackers are mainly caused by any combination of the following:

1. Accidents at firecracker manufacturing unit
  - i. Fireworks are made of pyrotechnic chemical which are capable of emitting heat, light, sound, gas on ignition. Charcoal is the most commonly used fuel in the industry. As the industry operates prior to 'festive season', the manufacturing units are forced to work under immense pressure to meet production targets for the upcoming festival season (Dussehra – Diwali/Deepawali - New Year). Most accidents reported are due to illegal units operating without valid license / permits, lack skilled workers, lack safety regulations that include stocking excess explosives.
  - ii. There is inadequate knowledge on the stipulations on the quantity of explosive material to be used / mixed in making firecrackers.
  - iii. Accidents occur either during processing, storage and transportation of fireworks in manufacturing units.
  - iv. A study (Ref. #1) conducted for manufacturing units in Tamil Nadu highlighted:
    - a. Various unit operations such as weighing, sieving, mixing, filling, fuse cutting, drying and finishing activity of fireworks manufacturing.
    - b. The study explored the various possible hazards during manual processing and handling of fireworks mixtures.
    - c. Analysis showed that most of the fatal accidents in fireworks industry occurred in filling and mixing sections.
    - d. Hot weather is one another major contributing factors. This showed that fireworks chemicals are susceptible to thermal stimuli.

An analysis (Ref #2) of accident data reported in the fireworks units during 1989-2013 in Sivakasi, a small town in southern part of Tamilnadu, India showed that the main cause of an accident is inadequate knowledge of the mechanical, thermal and electrostatic sensitivity of fireworks mixtures. The accident data analysis is given below under the following four categories based on the causative factors:

- a. Fireworks mixtures: About 31% of accidents occurred during the manufacturing of cracker mixtures and 25% while

- processing tip mixtures. The remaining 44% accidents occurred during processing of various non cracking and fancy fireworks.
- b. Unit operations: 59% of the reported accidents occurred in the filling and mixing sections and other accidents occurred in the storage facility, fuse cutting operations, drying process, burning of fireworks wastes and packing processes.
  - c. Causes: 36% of the accidents were due to ignition as a result of friction and 25% were due to impact. Other accidents were due to lightning, and static electricity.
  - d. Characteristic influence of climate and weather conditions: Most accidents in fireworks industry occurred in the month of April-May. This is due to the peak summer season

**Table 3.1: Causes of Hazards during manufacturing problems**

Cause	Hazards in manufacturing
<b>Production Phase</b>	Cause Manual Mixing of Chemicals Impact, Friction, Static electricity charges, Human errors
<b>Drying on Heating Platforms</b>	Dust accumulation, overheating
<b>Transportation</b>	Careless Handling, Impact loading Over loading, Dragging of materials
<b>Ref: International Journal of Environmental Engineering and Management. ISSN 2231-1319, Volume 4, Number 3 (2013), pp. 259-264</b>	

2. In transit / at storage site
  - a. Several accidents during processing, storage and transportation have been reported in Indian fireworks manufacturing units.
  - b. There is illegal transportation of fireworks in public transport , trains and cars without necessary permits
3. During fireworks display and during public display of fireworks  
A separate chapter discusses accidents caused due to ‘public display’ of fireworks  
(Ref: Ref#1: Accident data analysis and hazard assessment in fireworks manufacture Article in Science and Technology of Energetic Materials 69(5):161-168 · July 2008;  
Ref #2: [http://shodhganga.inflibnet.ac.in/bitstream/10603/24257/6/06\\_chapter1.pdf](http://shodhganga.inflibnet.ac.in/bitstream/10603/24257/6/06_chapter1.pdf)

### **3.4 Concerns expressed by some NGOs on hazards of firecrackers**

There have been several complaints from the public and organizations across the country highlighting the annoyances due to excessive sound levels & air pollution during festivals. The following three cases briefly highlight the concerns / issues on the matter.

a. Awaaz Foundation, Maharashtra:

Tests conducted on firecrackers by NGO Awaaz Foundation and Maharashtra Pollution Control Board (MPCB) revealed that several manufacturers are flouting Supreme Court directives on noise levels as well as the quantity of heavy metals used in the products. Key observations of survey are:

- i. Many manufacturers had either not listed the chemical composition or had given incomplete information on the boxes.
- ii. Assesses that out of the 27 crackers tested, 17 did not specify noise levels. Serial crackers and rassi bombs exceeded maximum permissible limits.
- iii. While the use of crackers have reduced over the last few years, the decibel levels remain unchanged.
- iv. All serial crackers crossed the threshold of accepted noise limits, with a majority recording more than 125 dB, 11 of 14 crackers.

b. Om Birangana Religious Society v. State, 100 CWN 617

The use of Fireworks causes air pollution as noise and smoke. Their excessive use has raised concerns as a public hazard and violation of their fundamental rights as enshrined in the Constitution of India. It has been held in the case of "Om Birangana Religious Society v. State, 100 CWN 617 that the '*Freedom of speech and expression guaranteed under Article 19(1)(a) of the Constitution of India includes, by necessary implication, freedom not to listen and/or to remain silent. A citizen has a right to leisure, right to sleep, right not to hear and right to remain silent. He also has the right to read and speak with others*'. Because of the tremendous sound and noise, the citizens cannot exercise all these fundamental rights. It has been seen that firecrackers noise is an impulsive noise and is hazardous. Bursting of a firecracker near the ear can lead sometimes to non-recoverable hearing loss.'

c. The Citizens Committee, Goa on Noise Pollution

Some salient observations:

- i. Residents are suffering the ill effects of excessively noisy and dangerous firecrackers.
- ii. Need display noise levels, chemical content on packaging and restriction on use of hazardous chemicals
- iii. Need to regulate the "sale & use" of firecrackers

### 3.5 Bursting firecrackers impacts health

1. Firecracker noise is an impulsive noise and is hazardous. Bursting of firecrackers near the hearing vicinity can lead sometimes to non-recoverable hearing loss.



2. As bursting of firecrackers is 'seasonal' event having several point sources thus it is a major challenge in assessing the overall impact of emissions / noise to the environment. Firecrackers are used on several festive occasions however the impacts of firecrackers are more significant during Deepawali (festival of light), a festival which is celebrated nation-wide hence data for comparison is available w.r.t. this period for rise in noise levels & deterioration in ambient air quality.
3. Firecrackers are made of chemicals / metallic agents some of which may be toxic. The major constituent of smog that forms from firecracker emissions contain SO<sub>x</sub>, NO<sub>x</sub> along with generation of significant dust (particulate matter) that may contain the following heavy metals. Emission from firecrackers have been reported to have the following effects:
  - a) The children breathe toxic air and suffer from nasal irritation and throat congestion.
  - b) The smoke also irritates the eyes cause tears and redness.
  - c) Bursting crackers may increase blood pressure and aggravate heart disease.
  - d) Nausea, headache and giddiness are common effects of bursting crackers.
  - e) Lung infections such as coughing, sneezing, respiratory disorders like asthma, wheezing often get severe during Deepawali festival. The pollution hazards such as the toxic smoke causes a lot of discomfort in breathing.
  - f) The poisonous gas can also affect pregnant women adversely. It may also affect the mentally ill patients leading to depression, fear and stress.
4. Besides the above, lack of safety measures also cause serious accidents varying from serious burns and injuries to death in some cases.

### **3.6 Non - stoichiometric composition in firecrackers is harmful**

CPCB has not conducted any health impacts studies caused due to noise / emission from firecrackers. Due to lack of information available on health effects from bursting of firecrackers in Indian cities, the following information has been compiled from research papers in



external journals / papers. Fireworks are made of pyrotechnic chemical which are capable of emitting heat, light, sound, gas on ignition. The lighting effects and noise levels depend on the chemistry of fireworks and the combustive features of the ingredients, the major concern being inappropriate stoichiometric amounts of the ingredients in making common firecrackers. Firecrackers are made of chemicals / metallic agents some of which are toxic when they are burst. The major constituents of smog that forms from firecracker emissions contain SO<sub>x</sub>, NO<sub>x</sub> and significant dust load or particulate matter that may contain the following heavy metals ex. Pb, Hg, Sr, Li, Al etc. Table below provides an overview of immediate / long term effects of commonly used ingredients used in making firecrackers.

**Table 3.2: Hazardous & toxic nature of ingredients used in firecrackers**

<b>Compound</b>	<b>Environmental Effects</b>
<b>Aluminium</b>	Contact dermatitis, bioaccumulation
<b>Sulfur Dioxide</b>	Acid rain from sulphuric acid affects water sources, vegetation & causes property damage.
<b>Potassium Nitrate</b>	Toxic dusts, carcinogenic sulfur-coal compounds
<b>Perchlorate - Ammonium &amp; Potassium</b>	Can contaminate ground & surface waters, can cause thyroid problems in humans & animals
<b>Barium Nitrate</b>	Poisonous. Fumes can irritate respiratory tract.
<b>Copper compounds</b>	Polychlorinated dioxins and di-benzofurans. Can bio-accumulate. Cancer risk.
<b>Antimony sulfide</b>	Toxic smoke, possible carcinogen
<b>Lead Dioxide / Nitrate / Chloride</b>	Bio-accumulation, developmental danger for kids & unborn babies, may remain airborne for days, poisonous to plants & animals
<b>Lithium compounds</b>	Toxic and irritating fumes when burned
<b>Mercury (Mercurous chloride)</b>	Toxic heavy metal. Can bio-accumulate.
<b>Nitric oxide</b>	Toxic by inhalation. Is a free radical
<b>Nitrogen dioxide</b>	Highly toxic by inhalation.
<b>Ozone</b>	Greenhouse gas that attacks & irritates lungs
<b>Arsenic compounds</b>	Toxic ash can cause lung cancer, skin irritation and wart formation.
<b>Strontium compounds</b>	Can replace calcium in body. Strontium chloride is slightly toxic.
(Ref : <a href="http://www.backcountryattitude.com/toxic_fireworks.html">http://www.backcountryattitude.com/toxic_fireworks.html</a> )	

### 3.7 Firecracker accidents: at place of manufacture

Accidents in fireworks manufacturing units are a major threat to the society due to their devastating effects. Chronology of major fire accidents in firecracker making units: (Indian Express April 11, 2016)

- i. **July 2, 2005:** 12 persons were killed and 22 injured in a fire accident at Anuppankulam in Sivakasi.
- ii. **July 25, 2005:** Six employees of a private fireworks unit were injured in an accidental fire at a cracker unit at Anuppankulam near Sivakasi.
- iii. **April 20, 2006:** Four people including a woman were killed in a blast in a cracker unit in Sivakasi.
- iv. **July 7, 2009:** Seventeen workers of a cracker factory were burnt to death in a fire accident in the Madurai district of Tamil Nadu.
- v. **July 20, 2009:** Eighteen people killed and 33 injured 23 of them seriously, when a fire swept through the unit which makes crackers at Namaskarichanpatti in Virudhunagar District.
- vi. **July 28, 2009:** Three workers killed in the mishap at Anil Fireworks in Keezha Tiruthangal village in Sivakasi
- vii. **August 3, 2009:** One died in the accident at Classic Fireworks in Meenampatti in Sivakasi.
- viii. **August 29, 2009:** Two workers killed and three others injured in a fire accident at a cracker unit in Sattur.
- ix. **March 30, 2010:** One person killed and six others injured in a blast at a country-made cracker unit on South Car Street in Dindigul.
- x. **August 5, 2010:** An eight-year-old boy was killed in a fire accident reportedly at an illegal cracker unit functioning in a house near Sivakasi.
- xi. **August 10, 2010:** Eight state government officials suffered severe burns when firecrackers stored at an illegal godown they raided exploded accidentally at Duraisampuram village, near Sivakasi.
- xii. **August 26, 2010:** A fireworks employee was killed in a fire accident in a cracker unit near Virudhunagar.
- xiii. **October 17, 2010:** Three persons were charred to death and three others suffered burns when a godown of a cracker manufacturing unit at Ellappan Pettai village, near Cuddalore.
- xiv. **January 21, 2011:** Eight workers were charred to death and sixteen, including five women, were injured in an explosion that took place at a fireworks unit near Virudhunagar.
- xv. **March 22, 2011:** Crackers worth lakhs of rupees were destroyed in a fire that broke out in a godown at A Lakshmiapuram, near Sivakasi.
- xvi. **June 5, 2011:** A woman worker was killed and another injured in a fire accident at a cracker unit near Sattur.
- xvii. **August 6, 2011:** Six women workers were killed in an accident following an explosion that took place in a fireworks factory near Sivakasi.

- xviii. **Oct 3, 2011:** Two workers were killed in an explosion that took place in a fireworks factory near Sattur.
- xix. **December 28, 2011:** Four workers were killed on the spot and two others injured in an explosion at a cracker-manufacturing unit near Sivakasi.
- xx. **February 3, 2012:** A worker was injured in a fire accident at a fireworks unit in Sevalpatti on Friday.
- xxi. **Feb 28, 2012:** Two labourers of a firecracker-manufacturing unit, who were seriously injured in a blast died at a private hospital in Madurai.
- xxii. **March 7, 2012:** A blast at a fireworks unit in Sivakasi claimed the life of one worker and left another seriously injured. The incident occurred at National Paper Caps in Aiyandar Colony.
- xxiii. **May 10, 2012:** A 70-year-old man was burnt to death in an explosion at a fire cracker manufacturing unit in Sivakasi in Virudhunagar district.
- xxiv. **March 27, 2012:** Two workers who sustained serious burn injuries in a blast at a fireworks unit in Sankarapandiapuram near Sattur succumbed to the injuries at a private hospital in Madurai.
- xxv. **Aug 10, 2012:** A worker at a cracker unit was critically injured in a fire accident at a fireworks unit at Thulukkakurichi near Vembakottai.
- xxvi. **Aug 13, 2012:** A woman employee of a fireworks unit was killed in a fire accident at a cracker unit in Maraneri near Virudhunagar.
- xxvii. **Sept 05, 2012: Sivakasi, Tamil Nadu factory explosion** (5 September 2012): The explosion occurred within the factory premise of firecracker manufacturing unit – m/s Om Sakthi Fireworks Industries. The Om Sakthi Fireworks Industries complex consisted of a single larger factory unit and 48 ancillary units. The company's fireworks license had been suspended only days earlier for violation of worker safety rules. 40 people were killed and more than 70 injured in the accident in September 2012.



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## The Explosives Act and Rules framed thereunder

### Explosives Act, 1884 & Explosives Rules, 2008

- i. Issues regarding licences issued for possession and sale etc. of fireworks is dealt under the Explosives Act, 1884 and Rules (Explosives Rules, 2008) framed thereunder
- ii. Class 7 thereof relates to fireworks : in Schedule I to the Explosives Rules, 2008 (for short 'the Rules')
- iii. Class 7 relates to fireworks which are categorized into FOUR divisions, namely, Division 1, Division 2, Division 3, and Division 4.
  - a) Division 1 comprises 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, and is not an explosive of classes 1,2,3,4,5 & 6, any star and any coloured fire composition:  
Provided that a substantially constructed hermetically closed metal case, containing not more than 500 grammes of coloured fire composition of such a nature, as not to be liable to spontaneous ignition shall be deemed to be "a manufactured firework" and not a "firework composition".
  - b) Division 2 fireworks comprises manufactured fireworks i.e., to say any explosive of class 1,2,3,4 or 6 and any fireworks composition when such explosive or composition is enclosed in any case or contrivance or other articles specially adapted, for the production of pyrotechnic effect for pyrotechnic signal or sound signals.  
Division 2 fireworks comprises 3 sub-divisions, namely, sub-division 1, sub-division 2 and sub-division 3.
    - Sub-division 1 of Division 2 fireworks comprises low hazard fireworks which, in the opinion of Chief Controller are relatively innocuous in themselves and are not liable to explode violently or all at once, e.g., sparklers [Chinese crackers, serpents, etc.].
    - Sub-division 2 of Division 2 of fireworks comprises high hazard fireworks which, in the opinion of Chief Controller, present a special hazard to a person, e.g., rockets, shells, maroons, wheels, barrages, fountains, illumination pieces, distress

- signals, pyrotechnic devices etc.
- Sub-division 3 of Division 2 fireworks comprises such fireworks, which are assembled at site purely for the purpose of display.
  - c) Division 3 comprises any explosive contrivance required for the manufacture of manufactured fireworks, e.g., quick match fuse, micro cord fuse, etc.
  - d) Division 4 comprises manufactured fireworks for use of Armed Forces of the Union.”
- iv. Section 5 of the Act confers the power to make Rules as to licensing of the manufacture, possession, use, sale, transport, import and export of explosives that includes fireworks.
- v. Rule 2(19) defines “**display fireworks**” as a group of authorized manufactured fireworks assembled at site, solely for the purpose of display.
- vi. Definition of “**fireworks**”: Rule 2(24) defines “fireworks” as low hazard explosive comprising of any composition or device manufactured with a view to produce coloured fire or flame, light effect, sound effect, smoke effect (coloured or natural), or combination of such effects and includes fog-signals, fuses, rockets, shells, percussion caps.
- vii. Definition of “**fireworks composition**”: Rule 2(25) defines “fireworks composition” as any chemical compound or mechanically mixed preparation of an explosive or inflammable substance that is used for the purpose of making manufactured fireworks and is not included in any other class of explosives, and includes any star or colored fire composition.
- viii. Definition of “**manufactured fireworks**”: Finally, Rule 2(32) defines “manufactured fireworks” as low hazard explosive contrivance containing explosive or combination of different classes, namely, Class 1 or Class 2 or Class 3 or Class 4 or Class 6 given in Part 1 of Schedule I of these rules or any explosives that come under Division 2 or Division 3 or Division 4 under Class 7 given under the said Part.
- ix. **Classifications of explosives**: Rule 4 deals with the classifications of explosives and as far as fireworks are concerned, they are categorized into (a) sound emitting fireworks, (b) colour or light emitting fireworks, (c) display fireworks and (d) fireworks for export purposes. The main focus is generally on (a) sound emitting fireworks, (b) colour or light emitting fireworks, (c) display fireworks

“4. **Classification of explosives.** - If any explosive falls within the limits of more than one class as defined in Schedule I, it shall be deemed to belong exclusively to the last number of such classes.

The fireworks are classified into the following categories depending upon the desired pyrotechnique effect:

- **Sound emitting fireworks.**

Fireworks with sound level not exceeding 125 dB (AI) or 145 dB (C) pk at 4 meters distance from the point of bursting.

For individual fire-cracker constituting the series (joined fire-crackers), the above mentioned limit be reduced by  $5 \log_{10}(N)$  dB, where N = number of crackers joined together;

- **Colour or light emitting fireworks.**

Such fireworks which emit colour or light and having sound level not exceeding 90 dB (AI) at 4 m distance from the point of bursting;

- **Display Fireworks.**

Any product of fireworks assembled at the site for the purpose of display including shell of diameter exceeding 25 mm, multiple shots or cake products of any diameter exceeding 25 nos., of shots in a product and lance network or other products as approved by the Chief Controller.”

x. Rule 9(5) provides that possession of fireworks, not exceeding one hundred kilogram for own use and not for sale does not require any licence to be issued, notwithstanding anything contained in Rule 7 of the Rules.

xi. Rule 15 relates to marking on explosives and packages. As per sub-Rule (i), (ii) and (iii) thereof, packages of fireworks shall contain the following markings in a conspicuous indelible character, by means of a stamping, embossing or painting. The relevant portion of this Rule reads thus: “15. Marking on explosives and packages. — Marking on packages. — (i) The outer package shall be marked in conspicuous indelible character, by means of a stamping, embossing or painting with — the word “EXPLOSIVES”; the name of authorised explosive; the number if any of the Class and the Division including sub-division to which it belongs; the safety distance category of explosive; the name of the manufacturer; identification number of the package; the net weight of explosives; gross weight of the package; date of manufacture and batch number; UN Classification and UN Identification number (for export packages); in case of plastic explosives, the words “marking agent added as per International Civil Aviation Organisation Resolution A 27-8” referred in sub-clause (iv) of clause (c) under sub-rule (2) of rule 10;

and a paper slip containing the above details shall be kept inside the package: Provided that in the case of safety fuse or fireworks, clauses (a) and (1) may be omitted and the words “safety fuse” or “Fireworks” shall be marked.

In case of fireworks, the names of the items, for example - amorces, paper caps, serpents eggs, etc., as appropriate shall be marked.

Every manufacturer shall on the box of each fire cracker shall mention details of its chemical content, sound level and that it satisfies requirements as laid down by the Chief Controller. Fire-cracker meant for export shall have a different colour packing from those intended to be sold in India and a clear print indicating that they are not to be sold in India.”

Sub-Rule 4 of Rule 15 of the Rules reads as follows: “(4) **Marking on fireworks.**— In case of fireworks, explosive composition, quantity of such composition, whether sound emitting crackers or colour or light emitting crackers, sound level, a caution or warning indicating the name of the item, manufacturer’s name, method of firing and precautions to be taken both in words and pictorial view shall be printed on each piece of fireworks and cardboard box and where adequate space is not available on the fireworks, such caution or warning shall be printed on a separate label and inserted in the smallest packet or carton.”

xii. Chapter VII of the Rules relates to special provisions for possession, sale and use of explosives. Rule 75 therein provides for a permit to be issued for temporary possession of manufactured fireworks in excess of the licensed quantity and this provides that a permit for a period not exceeding thirty days may be granted by the licensing authority to a licensee for fireworks shop to possess one-third in excess of the licensed quantity on receipt of the appropriate fees. Rule 84 of the Rules provides for temporary shops for possession and sale of fireworks during festivals and this reads: “84. Temporary shops for possession and sale of fireworks during festivals.—During festivals, the District Magistrate may issue temporary licences for possession and sale of fireworks in a temporary shop subject to the following conditions, namely:—

- (1) The fireworks shall be kept in a shed made of non-flammable material, which is closed and secured so as to prevent unauthorised persons having access thereto.
- (2) The sheds for possession and sale of fireworks shall be at a distance of at least three metres from each other and fifty metres from any protected work.



- (3) The sheds shall not face each other.
- (4) No oil burning lamps, gas lamps or naked lights shall be used in the shed or within the safety distance of the sheds. Electrical lights, if used, shall be fixed to the wall or ceiling and shall not be suspended by flexible wire. Switches for each shop shall be fixed rigidly to the wall and a master switch shall be provided for each row of sheds.
- (5) Display of fireworks shall not be allowed within fifty metres of any shed.
- (6) In one cluster not more than fifty shops shall be permitted.”

xiii. Chapter VIII of the Rules relates to the grant or refusal of approval, no objection certificate, licence, certificates, amendment, transfer and renewal of licences. Rule 99 therein provides that licences and certificates, for a specific purpose may be granted by the authorities, specified in Part 1 of Schedule IV of the Rules. Rule 106 provides for the period of validity of the licence granted under the Rule while Rule 113 provides for documents to be furnished for approval and grant of a licence and the relevant Form required to be filled up by an applicant.

xiv. Schedule IV referred to in Rule 99 of the Rules, particularly Part 1 thereof is required to be read with Rule 113 of the Rules and from a perusal of items 5 and 6 thereof, the limits for possession and sale of fireworks, the relevant licensing application form and the licensing authority are indicated.

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## Pollution control measures - chemical composition of firecrackers

### 5.1 Chemicals generate sparkle, colour & sound to firecrackers

LIGHT and COLOUR are important aspects of fireworks which depend on two basic physico-chemical properties:

- i. Incandescence: Incandescence is the light produced from heat. Heat causes a substance to grow hot and glow. Heat is required to generate colour which instantly sets off chemical reactions within the ingredient mixture of the firecrackers thereby change of colours are observed ex. from red, orange, yellow, and white light as the mixture gets increasingly hot.
- ii) Luminescence: In this case light is produced using energy other than heat.

**Table 5.1: Colour producing compounds used in firecrackers**

Metal & Its Compounds	Colour
<b>Strontium Salts &amp; Lithium Salts (<math>\text{Li}_2\text{CO}_3</math>, <math>\text{SrCO}_3</math>)</b>	Red
<b>Calcium Salts (<math>\text{CaCl}_2</math>, <math>\text{CaSO}_4 \cdot 2\text{H}_2\text{O}</math>)</b>	Orange
<b>Incandescence of Iron or Charcoal</b>	Gold
<b>Sodium Compounds (<math>\text{NaNO}_3</math>, <math>\text{Na}_3\text{AlF}_6</math>)</b>	Yellow
<b>White Hot Metal (<math>\text{BaO}</math>)</b>	Electric White
<b>Barium compounds with Chlorine (<math>\text{BaCl}_2</math>)</b>	Green
<b>Copper Compounds and Chlorine, <math>\text{Cu}_3\text{As}_2\text{O}_3\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2</math></b>	Blue
<b>Mixture of Strontium (red) and Copper (blue) compounds</b>	Purple
<b>Burning aluminium, titanium or magnesium powder</b>	Silver

Ref.: C. Martin - Alberca, C. Garcia-Ruiz / Trends in Analytical Chemistry 56 (2014) 27–36; Analytical techniques for the analysis of consumer fireworks, (Elsevier: [https://www.researchgate.net/publication/260030498\\_Analytical\\_techniques\\_for\\_the\\_analysis\\_of\\_consumer\\_fireworks](https://www.researchgate.net/publication/260030498_Analytical_techniques_for_the_analysis_of_consumer_fireworks) )

Charcoal is the most commonly used fuel in the industry. The chemistry of fireworks is based on combustive features of the ingredients used and the lighting effects that are generated. Based on literature survey the following are the key ingredients that go into making fireworks:

- i. Fuel: Charcoal i.e. black powder is the most common fuel used in fireworks.
- ii. Oxidizing Agents: The function of the oxidizing agent is to produce the oxygen needed in order to burn the mixture within the fireworks. It can be nitrates, chlorates or per-chlorates etc.
- iii. Reducing Agents: It needs to burn oxygen provided by the oxidizing agents. Common reducing agents are Sulphur and Charcoal and these react with oxygen to form sulphur dioxide and carbon dioxide respectively
- iv. Regulators: Metals (like aluminium, titanium, copper, strontium, barium etc.) can be added to regulate the speed of the reaction and colouring agents.
- v. Binders: Binders are used to hold the mixture of the firework together in a paste like mixture. The most commonly used binder is known as dextrin, a type of starch. Paron can also be used in binding, however it is less common and only used in conjunction with red and green fireworks as it helps to enhance their colour. The binders do not actually begin to work until the firework has been lit and are potentially dangerous.
- vi. Colouring Agents: Different chemicals are used to produce coloured fireworks.

**Table 5.2: Compounds that add sparkle to firecrackers**

<b>Compound</b>	<b>Purpose usage</b>	<b>Compound</b>	<b>Purpose usage</b>
<b>Lead Dioxide / Nitrate / chloride</b>	oxidizer	Aluminium	Brilliant whites
<b>Lithium compounds</b>	blazing reds	Potassium Nitrate	In black powder
<b>Mercury (Mercurous chloride)</b>	chlorine donor	Ammonium & Potassium	propellant / oxidizer
<b>Barium Nitrate</b>	glittering greens	Copper compounds	blues
<b>Arsenic compounds</b>	Used as colorants.	Antimony sulphide	glitter effects

## 5.2 Hon'ble SC's directions on evaluation of firecrackers based on chemical composition

In reference to the order passed by Hon'ble Supreme Court on 18<sup>th</sup> July 2005 (Matter no 733 on Noise Pollution) '174 (1) *On a comparison of the two systems, i.e. the present system of evaluating fire-crackers on the basis of noise levels and the other where the fire-crackers shall be evaluated on the basis of chemical composition, we feel that the latter method is more practical and workable in Indian circumstances. It shall be followed unless and until replaced by a better system.*

## 5.3 Noise levels for Light emitting firecrackers – Explosive Rules 2008

The fireworks are classified into the following categories depending upon the desired pyro-technique effect:

- a) Sound emitting fireworks.
- b) Colour or light emitting fireworks.  
Such fireworks which emit colour or light and having sound level not exceeding 90 dB (AI) at 4 m distance from the point of bursting;
- c) Display Fireworks.

## 5.4 Explosives & Pyrotechnics Sectional Committee - BIS

To formulate Indian Standards for terminology, methods of sampling and test, packaging, codes of practice and specifications for commercial explosives and their accessories, pyrotechnics and fireworks preparations, safety matches and their raw materials is the scope of Bureau of Indian Standards (BIS) **CHD 26** Explosives & Pyrotechnics Committee. The scope of CHD 26 is as given under:

- “a) To formulate Indian Standards for terminology, methods of sampling and test, packaging, codes of practice and specifications for commercial explosives and their accessories, pyrotechnics and fireworks preparations, safety matches and their raw materials; and*
- b) To coordinate with the work of other international agencies”.*

The technical committee on firework, CHD 26, has published 64 Indian Standards and 2 standards are under development, the Standards are based on chemicals used for manufacture of explosives and pyrotechnics, methods of test and packaging materials. The details are given in Table below.

**Table 5.3: List of Indian Standards (BIS) published on Fireworks**

<b>Sl. No.</b>	<b>IS No. &amp; Year</b>	<b>Title</b>	<b>Reaffirmation Year/Month</b>	<b>No. of Amendments</b>
1.	IS 301 : 1982	Potassium nitrate for explosive and pyrotechnic compositions	Mar-2016	1
2.	IS 438 : 2006	Aluminium powder for explosive and pyrotechnic compositions	Mar-2016	1
3.	IS 708 : 1987	Potassium chlorate for explosive and pyrotechnic industry	Mar-2016	1
4.	IS 1091 : 1985	Nitrocellulose	Mar-2016	0
5.	IS 2012 : 2006	Red Phosphorus - Specification	Mar-2016	0
6.	IS 2307 : 2004	Magnesium Powder for Explosive and Pyrotechnic Compositions	Mar-2016	1
7.	IS 2653 : 2004	Safety Matches in Boxes	Mar-2016	1
8.	IS 4396 : 1981	Barium nitrate for explosive and pyrotechnic compositions	Mar-2016	1
9.	IS 4668 : 1985	Ammonium Nitrate For Explosives	Mar-2016	2
10.	IS 5670 : 1984	Lead thiocyanate for explosive and pyrotechnic compositions	Mar-2016	1
11.	IS 5671 : 1984	Strontium nitrate for pyrotechnic compositions	Mar-2016	1
12.	IS 5713 : 1981	Manganese dioxide for explosive and pyrotechnic compositions	Mar-2016	0

<b>Sl. No.</b>	<b>IS No. &amp; Year</b>	<b>Title</b>	<b>Reaffirmation Year/Month</b>	<b>No. of Amendments</b>
13.	IS 5731 : 1970	Antimony sulphide for explosive and pyrotechnic compositions	Mar-2016	2
14.	IS 6609 ( Part 1) : 1972	Methods of test for commercial blasting explosives and accessories Part I Gun powder	Mar-2016	0
15.	IS 6609 ( Part 2 / Sec 1) : 1973	Methods of test for commercial blasting explosives and accessories Part II Explosives Section 1 Explosives general	Mar-2016	0
16.	IS 6609 ( Part 2 / Sec 2) : 1974	Methods of test for commercial blasting explosives and accessories Part II Explosives Section 2 Explosives permitted	Mar-2016	1
17.	IS 6609 ( Part 2 / Sec 3) : 1980	Methods of test for commercial blasting explosives and accessories Part II Explosives Section 3 Explosives slurry	Mar-2016	0
18.	IS 6609 ( Part 3) : 1973	Methods of test for commercial blasting explosives and accessories Part III Detonators general and permitted	2013	0
19.	IS 6609 ( Part 4) : 1984	Methods of test for commercial blasting explosives and accessories Part IV Detonating fuses	Mar-2016	0
20.	IS 6609 ( Part 5) : 1972	Methods of test for commercial blasting explosives and accessories Part V	Mar-2016	0

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

<b>Sl. No.</b>	<b>IS No. &amp; Year</b>	<b>Title</b>	<b>Reaffirmation Year/Month</b>	<b>No. of Amendments</b>
		Safety fuses		
21.	IS 7124 : 1973	Gun Powder	Mar-2016	1
22.	IS 7401 : 1987	Paraffin wax for explosive and pyrotechnic industry	Mar-2016	1
23.	IS 7526 : 1996	Detonating Fuses	2013	0
24.	IS 7588 : 1992	Barytes for explosives and pyrotechnic composition	Mar-2016	0
25.	IS 7589 : 1974	China clay for explosive and pyrotechnic industry	Mar-2016	0
26.	IS 7602 : 1975	Lead chromate for explosive and pyrotechnic compositions	Mar-2016	0
27.	IS 7632 : 1975	Detonators	Mar-2016	0
28.	IS 7633 : 1982	Calcium carbonate for explosive and pyrotechnic industry	Mar-2016	1
29.	IS 7738 : 1975	Safety fuse for commercial use	Mar-2016	0
30.	IS 7886 : 1997	Barium chromate for explosive and pyrotechnic industry - Specification	Mar-2016	0
31.	IS 8063 : 1976	Red lead for explosive and pyrotechnic industry	Mar-2016	1
32.	IS 9600 : 1980	Safety matches in booklets	Mar-2016	0
33.	IS 9880 : 1981	Wax coated paper splints	Mar-2016	1
34.	IS 10081 : 1981	Terms Relating to Commercial Explosives Pyrotechnics and Blasting Practices	Mar-2016	0

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

<b>Sl. No.</b>	<b>IS No. &amp; Year</b>	<b>Title</b>	<b>Reaffirmation Year/Month</b>	<b>No. of Amendments</b>
35.	IS 10126 : 1986	Sparklers	Mar-2016	1
36.	IS 10212 ( Part 1) : 1986	General requirements for packages of explosives Part 1 Commercial high explosives	Mar-2016	1
37.	IS 10373 : 1982	Plastic boxes for safety matches	Mar-2016	0
38.	IS 10821 : 1984	Calcium Nitrate for Explosive Industry	Mar-2016	0
39.	IS 10977 : 1984	Pentaerythritol for explosive industry	Mar-2016	1
40.	IS 11483 : 1985	Amorces Paper caps for toy pistols	Mar-2016	1
41.	IS 11491 : 1985	Blasting soluble nitrocellulose for explosives industry	Mar-2016	1
42.	IS 11783 : 1986	Ferro-silicon For Explosive And Pyrotechnic Industry	Mar-2016	0
43.	IS 11803 : 1986	Magnesium Oxide For Explosive Ammunition Protective Compositions And Pyrotechnic Industry	Mar-2016	0
44.	IS 12238 : 1987	Colour and star matches in boxes	Mar-2016	0
45.	IS 12276 : 1988	Dextrin for explosives and pyrotechnic industry	Mar-2016	0
46.	IS 12437 : 1988	Zirconium powder for use in explosive and pyrotechnic industry	Mar-2016	1
47.	IS 12630 : 1989	Pyrotechnics - Fireworks black serpent pellets	Mar-2016	1
48.	IS 12631 : 1989	Pyrotechnics - Fireworks pencils	Mar-2016	1
49.	IS 12632 : 1989	Pyrotechnics - Fireworks Twinkling Stars	Mar-2016	1
50.	IS 12681 : 1989	Sodium Nitrate for Explosives and Pyrotechnics Industry	Mar-2016	0



**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

<b>Sl. No.</b>	<b>IS No. &amp; Year</b>	<b>Title</b>	<b>Reaffirmation Year/Month</b>	<b>No. of Amendments</b>
51.	IS 12684 : 1989	Calcium Stearate for Pyrotechnic Industry	Mar-2016	0
52.	IS 12739 : 1989	Fireworks Conical Flowerpots	Mar-2016	1
53.	IS 12980 : 1990	Fireworks rockets	Mar-2016	1
54.	IS 13227: 1991	Fireworks Whistles	Mar-2016	1
55.	IS 13522 : 1992	Charcoal for Explosives and Pyrotechnic Compositions	Mar-2016	2
56.	IS 13524 : 1992	Potassium Perchlorate for Explosives and Pyrotechnic Compositions	Mar-2016	0
57.	IS 13526: 1992	Sodium Perchlorate Solution for Explosives and Pyrotechnic Compositions	Mar-2016	0
58.	IS 1478 : 2000	Fireworks Signal Flares	Mar-2016	0
59.	IS 14931: 2001	Fire Works Wheel	Mar-2016	0
60.	IS 15073 ( Part 1) : 2002	Packaging of Electric Detonators - Part 1 Wooden Cases	2013	0
61.	IS 15073 ( Part 2) : 2008	Packaging of electric detonator Part 2 Corrugated fibreboard cases	2013	0
62.	IS 15074 ( Part 1) : 2002	Packaging of Non-Electric Detonators - Part 1 Wooden Cases	2013	0
63.	IS 15447 ( Part 1) : 2004	Commercial Blasting Explosives - Part 1 Nitroglycerine Based Explosives	Mar-2016	0
4.	IS 15447 ( Part 2) : 2008	Commercial blasting explosives Part 2 Slurry emulsion explosives	2013	0

### 5.5 Chemical composition of firecrackers by PESO: sound & light emitting firecrackers

- a) Hon'ble Supreme Court passed an order in W.P. (C) 72/1998, directing Petroleum & Explosive Safety Organization (PESO) to come up with chemical formulae for each type or category or class of firecracker & specify the proportion / composition as well as the maximum permissible weight of every chemical used in manufacturing firecrackers – the focus was on commonly used sound producing fire crackers.

In compliance with Hon'ble Supreme Court order (W.P. (C) 72/1998), vide letter dated 7<sup>th</sup> March 2008, Petroleum and Explosive Safety Organisation (PESO) (formerly Dept. of Explosives – DOE) released the following data:

- i. *the chemical formulae for four types of commonly used sound producing fire crackers namely **(a)** Atom Bomb, **(b)** Chinese Crackers, **(c)** Maroons & **(d)** Garland crackers*
- ii. *specifying the proportion/composition as well as maximum permissible weight of every chemical used in the manufacture of said fire crackers*
- iii. *prescribed chemical composition of four commonly sound producing firecracker specifying minimum permissible weights for Aluminium Powder, Sulphur, KNO<sub>3</sub> & BaNO<sub>3</sub>.*

The information for FOUR commonly used sound producing fireworks is tabulated below on the basis of the following:

- i. Physical Measurements
- ii. Chemical Composition
- iii. Weight
- iv. Packing / bulk density

**Table 5.4: Standards (PESO) for Composition of Firecracker: Atom Bomb**

Physical Measurements	Chemical Composition	Weight	Packing bulk density
Maximum 25g in weight, 40mm in length, 20mm in dia. or diagonal. Inner shell volume not exceeding 4.3cm <sup>3</sup> with shell made of paper of max. 240 Gsm, max. winding 5 Nos. and fitted with fuse of 6 to 9 sec delay.	Aluminium powder (999 / 666): 0.46g (23 %) Sulphur: 0.40g (20 %) KNO <sub>3</sub> : 0.94g (47 %) BaNO <sub>3</sub> : 0.20g (10 %) If BaNO <sub>3</sub> is not in the composition, KNO <sub>3</sub> will be 1.14g (57%).	Weight of Chemical not exceeding 2.0g per Atom Bomb.	Packing Bulk density not exceeding 0.6 g/cc per Atom Bomb

**Table 5.5: Standards (PESO) for Composition of Firecracker: Chinese Cracker** (this is a brand name and not imported product)

Physical Measurements	Chemical Composition	Weight	Packing bulk density
Overall size not exceeding 75mm in length and 15mm in dia. Inner shell max. length 57.5mm, dia. max.8mm and thickness 0.5mm having max. 4 Nos. of papers wrapping in the form outer shell and fitted with fuse of 6-9 sec delay.	Aluminium powder (999) : 0.138g (23 %) Sulphur : 0.120g (20 %) KNO <sub>3</sub> : 0.342g (57 %)	Weight of Chemical not exceeding 0.6g per cracker.	Packing Bulk density not exceeding 0.6 g/cc per cracker.

**Table 5.6: Standards (PESO) for Composition of Firecracker: Maroons**

Physical Measurements	Chemical Composition	Weight	Packing bulk density
Overall size not exceeding 100mm in length and 25mm in dia. Inner shell not exceeding 89.0mm in length, 6.0 in dia. and thickness not exceeding 1.0mm. Outer shell with max.8 Nos. of paper wrapping and fitted with fuse of 6-9 sec delay.	Aluminium powder (999) : 0.23g (23 %) Sulphur : 0.20g (20 %) KNO <sub>3</sub> : 0.57g (57 %)	Weight of Chemical not exceeding 1.0g per Maroon	Packing Bulk density not exceeding 0.6 g/cc per

**Table 5.7: Standards (PESO) for Composition of Firecracker: Garland Crackers**

Number of Crackers in a garland	Inner shell specification in mm (max.)			Maximum Chemical Quantity (in gms)	Maximum packing bulk density not exceeding (in gms)
	Length	Inner Dia.	Thickness (in mm)		
28	45.84	6	0.58	0.3	0.6
56	36.5	6	0.5	0.3	0.6
100	36.5	6	0.5	0.3	0.6
200	36.5	6	0.5	0.3	0.6
500	36.5	6	0.5	0.2	0.6

**Table 5.8: Chemical composition of firecrackers - SOUND and LIGHT emitting firecrackers**

FOUR types of LIGHT emitting firecrackers		FOUR types of NOISE generating firecrackers	
NAME	Chemicals	NAME	Chemicals
<b>GOLD SPARKLER</b>	Ba(NO <sub>3</sub> ) <sub>2</sub> , Al, Fe and dextrin	ATOM BOMB	Ba(NO <sub>3</sub> ) <sub>2</sub> , KNO <sub>3</sub> , Al, Sulphur
<b>ELECTRIC SPARKLER</b>	Ba(NO <sub>3</sub> ) <sub>2</sub> , Al, Fe, dextrin and aluminum flakes	CHINESE CRACKERS	KNO <sub>3</sub> , Al, Sulphur
<b>COLOUR SPARKLER</b>	Ba(NO <sub>3</sub> ) <sub>2</sub> / Strontium nitrate (SrBa(NO <sub>3</sub> ) <sub>2</sub> ). Al, colour donor and dextrin	MAROONS	KNO <sub>3</sub> , Al, Sulphur
<b>TWINKLING SPARKLER</b>	BaNO <sub>3</sub> , KNO <sub>3</sub> , Al, sulphur and dextrin	GARLAND FIRECRACKERS	KNO <sub>3</sub> , Al, Sulphur

### 5.6 Key ingredients used in FOUR commonly used sound producing firecrackers

The Hon'ble Supreme Court of India has banned the bursting of fire-crackers or any noise generating fireworks of high decibels to control the noise pollution. The Petroleum and Explosive Safety Organisation (PESO) (formerly Dept. of Explosives – DOE) has identified *the chemical formulae for four types of commonly used sound producing fire crackers namely (a) Atom Bomb, (b) Chinese Crackers, (c) Maroons & (d) Garland crackers.* The focus has been on the following four key ingredients used in making sound producing firecrackers - aluminium powder, sulphur, KNO<sub>3</sub> & BaNO<sub>3</sub>.

**Table 5.9: Ingredients used in FOUR common firecrackers**

Ingredients	Major uses	Hazardous nature
<b>Potassium nitrate (Oxidizers)</b>	Oxidizer used as component of black powder. It is usually employed in safety fuses and lift charges Other information: Burning aluminium, titanium or magnesium powder : Colour effect: Silver	Toxic dusts, carcinogenic sulfur-coal compounds
<b>Barium nitrate (Oxidizers)</b>	It can be used as oxidizer and green color agent in flames, smoke, and flash mixtures. It can produce white or silver effect with aluminium Other information : Barium compounds with Chlorine (BaCl <sup>+</sup> ) : Colour effect Green	Poisonous. Fumes can irritate respiratory tract.
<b>Aluminium (Fuel)</b>	It is the most widely used fuel. It produces brilliant flames and white sparks	Contact dermatitis, bioaccumulation
<b>Sulfur (Fuel)</b>	Used for white and colored smoke composition, flash and sound blends. It is a component of black powder. It could also be used as oxidizer in some mixtures	Acid rain from sulphuric acid affects water sources, vegetation & causes property damage.

### 5.7 Analyses of chemical composition of sound emitting firecrackers

In the Writ Petition (Civil) No. 728 of 2015 (I.A. No. 4) in the matter of Arjun Gopal & Ors. The Hon'ble Supreme Court vide its order dated 11.11.2016 directed '*...we direct the CPCB to study and prepare a report on the harmful effects of the materials which are currently being used in the manufacture of fireworks. The report shall be submitted within a period of three months to this Court*'.

As the laboratories of Central Pollution Control Board (CPCB) do not have the facilities to carryout analyses of chemical composition of firecrackers/explosives, attempt was made to get the same done by government laboratories. In compliance of Hon'ble Supreme Court's directions CPCB coordinated with various organizations, institutions, laboratories to undertake chemical analyses of fireworks (see table below)

**Table 5.10**

Sl. No.	Organizations, Institutions, Laboratories contacted	Feedback
1.	Petroleum & Explosives Safety Organization (PESO)	PESO also a respondent in the matter (as Respondent no. 6) Others institutions expressed inability to undertake chemical analyses of firecrackers
	Bhabha Atomic Research Centre (BARC)	
	Defence Research and Development Organization (DRDO)	
	High Energy Material Research Laboratory	
	Center for Fire, Explosive and Environment Safety (CFEES)	
	Forensic Laboratory, Govt. of Delhi	
	Thermo-fisher Scientific Laboratory, India.	
2.	Shriram Institute of Industrial Research (SIIR) , Delhi	Expressed willingness to undertake chemical analyses of firecrackers samples provided by CPCB (private laboratory).

The highlights of CPCB's affidavit submitted to the Hon'ble Court:

1. In compliance of the Court's direction CPCB's Affidavit with Annexures were displayed in its website for all respondents in the matter

2. On the basis of the analyses report received from Shriram Institute of Industrial Research (SIIR), Delhi, CPCB prepared a report showing the status of compliance with comparison with PESO's standards. The results indicated that some of the parameters were exceeding the prescribed chemical formulae prescribed by Petroleum and Explosives Safety Organization (PESO), Nagpur. (refer Table 5.16 Comparison of chemical compositions of firecrackers samples)
3. That bursting of firecrackers is a discrete event. CPCB has not carried out studies on the health impact of emissions from firecrackers. However, the known health impacts from bursting firecrackers caused due to their chemical composition was provided based on literature survey.
4. That fireworks are regulated under the Explosives Rules, 2008 which are applicable for regulating the manufacture, import, export, transport, and possession for sale or use of explosives.

**Table 5.1.1: Comparison of chemical compositions of firecrackers samples**

(Analysed by laboratory of Shiriram Institute of Industrial Research (SIIR), Delhi with reference to chemical formulae prescribed by Petroleum and Explosives Safety Organization (PESO), Nagpur)

Sl. No.	Name	Brand	Chemical component	Observations Concentration value (% by mass)	Prescribed limit of PESO, Nagpur (% by mass)
1.	Atom Bomb (Chemical analysis done for 100 gm. sample)	Cock Brand	1) Barium Nitrate [as Ba(NO <sub>3</sub> ) <sub>2</sub> ] (On the basis of Ba)	20.2 (Exceeding prescribed value of PESO)	10
			2) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K)	34.0 (Within the prescribed limit of PESO)	47
			3) Sulphur (as S) (Matter soluble in CS <sub>2</sub> )	29.9 (Exceeding prescribed value of PESO)	20
			4) Aluminium (as Al)	15.8 (Within the prescribed limit of PESO)	23
2.	Atom Bomb (Chemical analysis done for 100 gm. sample)	Cornation Brand	1) Barium Nitrate [Ba(NO <sub>3</sub> ) <sub>2</sub> ] (on the basis of Ba)	24.2 (Exceeding prescribed value of PESO)	10
			2) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K)	27.7 (Within the prescribed limit of PESO)	47
			3) Sulphur (S) (Matter soluble in CS <sub>2</sub> )	26.8 (Exceeding prescribed value of PESO)	20

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

<b>Sl. No.</b>	<b>Name</b>	<b>Brand</b>	<b>Chemical component</b>	<b>Observations Concentration value (% by mass)</b>	<b>Prescribed limit of PESO, Nagpur (% by mass)</b>
3.	Garland cracker (Chemical analysis done for 100 gm. sample)	Cock Brand	4) Aluminium (as Al)  1) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K) 2) Sulphur (as S) (Matter soluble in CS <sub>2</sub> )  3) Aluminium (as Al)	21.0 (Within the prescribed limit of PESO)  36.0 (Within the prescribed limit of PESO)  26.8 (Exceeding prescribed value of PESO)  15.8 (Within the prescribed limit of PESO)	23  57  20  23
4.	Chinese Cracker (Chemical analysis done for 100 gm. sample)	Cornation Brand	4) Barium Nitrate [as Ba(NO <sub>3</sub> ) <sub>2</sub> ] (On the basis of Ba) 5) Iron (as Fe)  1) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K) 2) Sulphur (S) (Matter soluble in CS <sub>2</sub> )  3) Aluminium (as Al)	0.1  19.4 (Within the prescribed limit of PESO)  35.7 (Exceeding prescribed value of PESO)  10.8 (Within the prescribed limit of PESO)	-  57  20  23



**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

<b>Sl. No.</b>	<b>Name</b>	<b>Brand</b>	<b>Chemical component</b>	<b>Observations Concentration value (% by mass)</b>	<b>Prescribed limit of PESO, Nagpur (% by mass)</b>
			4) Barium Nitrate [as Ba(NO <sub>3</sub> ) <sub>2</sub> ] (On the basis of Ba)	6.0	-
			5) Strontium Nitrate [as Sr(NO <sub>3</sub> ) <sub>2</sub> ] (on the basis of Sr)	10.9	-
			6) Magnesium (as Mg)	0.3	-
			7) Copper (as CuO) (on the basis of Cu)	2.0	-
			8) Bismuth (as Bi <sub>2</sub> O <sub>3</sub> ) (on the basis of Bi)	0.7	-
			9) Boron (Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ) (on the basis of B)	0.1	-
			10) Carbon (as C)	10.1	-
			11) Remainder Binder	4.0	-
5.	Chinese Cracker (Chemical analysis done for 100 gm. sample)	Panther Trade Mark	1) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K)	40.6 (Within the prescribed limit of PESO)	57
			2) Sulphur (as S) (Matter soluble in CS <sub>2</sub> )	26.7 (Exceeding prescribed value of PESO)	20
			3) Aluminium (as Al)	2.5 (Within the prescribed limit of PESO)	23
			4) Barium Nitrate	1.8	-

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

Sl. No.	Name	Brand	Chemical component	Observations Concentration value (% by mass)	Prescribed limit of PESO, Nagpur (% by mass)
			[Ba(NO <sub>3</sub> ) <sub>2</sub> ] (on the basis of Ba)		
			5) Strontium Nitrate [Sr(NO <sub>3</sub> ) <sub>2</sub> ] (on the basis of Sr)	0.1	-
			6) Magnesium (as Mg)	0.6	-
			7) Copper (as CuO) (on the basis of Cu)	1.1	-
			8) Titanium (as Ti)	0.2	-
			9) Boron (Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ) (on the basis of B)	0.2	-
			10) Carbon (as C)	21.9	-
			11) Remainder Binder	4.3	-
6.	Maroons (Chemical analysis done for 100 gm. sample)	Cock Brand	1) Potassium Nitrate (as KNO <sub>3</sub> ) (on the basis of K)	40.7 (Within the prescribed limit of PESO)	57
			2) Sulphur (as S) (Matter soluble in CS <sub>2</sub> )	22.3 (Exceeding prescribed value of PESO)	20
			3) Aluminium (as Al)	8.2 (Within the prescribed limit of PESO)	23
			4) Barium Nitrate [as Ba(NO <sub>3</sub> ) <sub>2</sub> ]	1.8	-

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

Sl. No.	Name	Brand	Chemical component	Observations Concentration value (% by mass)	Prescribed limit of PESO, Nagpur (% by mass)
			(on the basis of Ba)		
			5) Strontium Nitrate [Sr(NO <sub>3</sub> ) <sub>2</sub> ] (on the basis of Sr)	2.8	-
			6) Magnesium (as Mg)	2.7	-
			7) Copper (as CuO) (on the basis of Cu)	2.1	-
			8) Iron (as Fe)	0.1	-
			9) Boron (as Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ) (on the basis of B)	0.1	-
			10) Carbon (as C)	15.9	-
			11) Remainder Binder	3.3	-

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## Pollution control measures – ambient air quality during Diwali

### 6.1 Graded Response Action Plan (GRAP) for Delhi & NCR – includes impact from firecrackers

In pursuant to the Hon'ble Supreme Court's order dated December 02, 2016 in the matter of M. C. Mehta vs. Union of India regarding air quality in National Capital Region of Delhi, a Graded Response Action Plan has been prepared for implementation under different Air Quality Index (AQI) categories namely, Moderate & Poor, Very Poor, and Severe as per National Air Quality Index. A new category of "Severe+ or Emergency" has been added. Ministry of Environment, Forests & Climate Change has notified for implementation of GRAP through Environment Pollution (Prevention & Control) Authority vide S.O. 118 (E) dated January 12, 2017. Key issue relates **pollution** from firecrackers is given below

**Table 6.1: GRAP addresses ambient air quality (w.r.t. Firecrackers included)**

<b>Concentration : ambient PM<sub>2.5</sub> or PM<sub>10</sub></b>	<b>Action areas – under GRAP</b>	<b>Remarks w.r.t. ambient air quality</b>
Moderate to poor (ambient PM <sub>2.5</sub> or PM <sub>10</sub> concentration value is between 61-120 µg/m <sup>3</sup> or 101-350 µg/m <sup>3</sup> respectively)	<ul style="list-style-type: none"> <li>Strictly enforce Supreme Court ban on <b>FIRECRACKERS</b></li> </ul>	GRAP indirectly highlights that <b>FIRECRACKERS</b> pollute air quality

### 6.2 National Ambient Air Quality Standards

An air quality standard is a description of a level of air quality that is adopted by a regulatory authority as enforceable. The basis of development of standards is to provide a rationale for protecting public health from adverse effects of air pollutants, to eliminate or reduce exposure to hazardous air pollutants, and to guide national/local authorities for pollution control decisions. CPCB notified (<http://www.cpcb.nic.in>) in 2009 National Ambient Air Quality Standards (NAAQS) for 12 parameters [carbon monoxide (CO) nitrogen dioxide (NO<sub>2</sub>), sulphur

dioxide (SO<sub>2</sub>), particulate matter (PM) of less than 2.5 microns size (PM<sub>2.5</sub>), PM of less than 10 microns size (PM<sub>10</sub>), Ozone (O<sub>3</sub>), Lead (Pb), Ammonia (NH<sub>3</sub>), Benzo(a)Pyrene (BaP), Benzene (C<sub>6</sub>H<sub>6</sub>), Arsenic (As), and Nickel (Ni)] . The first eight parameters (includes SO<sub>2</sub> & PM) have short-term (1/8/24 hrs) and annual standards (except for CO and O<sub>3</sub>) and rest four parameters have only annual standards. The standards laid down in Schedule VII of the Environment (Protection) Rules, 1986 are as follows, the standards of the key parameters **SO<sub>2</sub> and particulate matter** concerning bursting of firecrackers are given below.

**Table 6.2: National Ambient Air Quality Standards (NAAQS, 2009)**

Sl. No.	Pollutant	Time weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of measurement
(1)	(2)	(3)	(4)	(5)	(6)
1.	Sulphur Dioxide (SO <sub>2</sub> ), µg/m <sup>3</sup>	Annual* 24 hours**	50 80	20 80	- Improved West and Gaeke - Ultraviolet fluorescence
2.	Particulate Matter (size less than 10µm) or PM <sub>10</sub> µg/m <sup>3</sup>	Annual* 24 hours**	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
3.	Particulate Matter (size less than 2.5µm) or PM <sub>2.5</sub> µg/m <sup>3</sup>	Annual* 24 hours**	40 60	40 60	- Gravimetric - TOEM - Beta attenuation

\* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

\*\* 24 hourly or 08 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year, 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

**Notes:** Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigations.

### 6.3 Air Quality Index (AQI)

Air Quality Index (AQI) is a tool for effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour (see - [http://cpcb.nic.in/FINAL-REPORT\\_AQI\\_.pdf](http://cpcb.nic.in/FINAL-REPORT_AQI_.pdf))

There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. Each of these categories is decided based on ambient concentration values of air pollutants and their likely health impacts (known as health breakpoints). The index has SIX colours schemes indicating the six categories. AQ sub-index and health breakpoints are evolved for eight pollutants which include **PM<sub>10</sub>**, **PM<sub>2.5</sub>** for which short-term (upto 24-hours) National Ambient Air Quality Standards are prescribed.

**Table 6.3: IND-AQI w.r.t. PM<sub>10</sub> and PM<sub>2.5</sub>**  
(See- [http://cpcb.nic.in/About\\_AQI.pdf](http://cpcb.nic.in/About_AQI.pdf)).

Type of AQI category	AQI Category and Colour scheme	AQI Range PM <sub>10</sub> µg/m <sup>3</sup>	AQI Range PM <sub>2.5</sub> µg/m <sup>3</sup>	Break point 24 hourly	
				PM <sub>10</sub>	PM <sub>2.5</sub>
I.	<b>Good</b>	0 – 50	0-30	50	<b>30</b>
II.	<b>Satisfactory</b>	51 – 100	31-60	100	60
III.	<b>Moderate</b>	101 – 250	61-90	250	90
IV.	<b>Poor</b>	251- 350	91-120	350	120
V.	<b>Very Poor</b>	351 – 430	121-250	430	250
VI.	<b>Severe</b>	430+	250+	430+	250+

The key parameters that impacts ambient quality on bursting of firecrackers are mainly **particulate matter**. Operational scheme of AQI system based to represent the present status of the air quality and its effects on human health is given in CPCB's report 'National Air Quality Index (May 2015)'

### 6.4 Ambient Air Quality monitoring during Diwali in year 2016

The following weblink gives a report on the ambient air quality in DELHI and ambient noise (manual) monitoring at Delhi and at CPCB's field offices during Diwali in year 2016 : Web link: [http://cpcb.nic.in/Deepawali\\_2016.pdf](http://cpcb.nic.in/Deepawali_2016.pdf)

### 6.5 Analyses of ambient air quality for metals / element during Diwali period (CPCB)

The Table below provides the chemical compositions of 'sound-emitting firecrackers' and 'light-emitting firecrackers' to CPCB as provided by PESO.

**Table 6.4: Composition of metals / elements in Firecrackers (PESO)**

Composition of SOUND-emitting firecrackers	Composition of LIGHT emitting firecrackers	Key Metals / Elements
Al	Al	Al (Aluminium)
BaNO <sub>3</sub>	BaNO <sub>3</sub>	Ba (Barium)
-	Fe	Fe (Iron)
KNO <sub>3</sub>	KNO <sub>3</sub>	K (Potassium)
S	S	S (Sulphur)
-	Sr	Strontium (Sr)

CPCB conducted monitoring and analysing ambient air quality levels for metals / elements covering 'Pre-Diwali', 'Diwali' & 'Post-Diwali' periods in Delhi in year 2016 for the SIX metals / elements in firecrackers viz. (Aluminium (Al), Barium (Ba), Iron (Fe), Potassium (K), Sulphur (S), Strontium (Sr) ) which are based on chemical composition of firecrackers as provided by PESO. The analytical results in Table below indicated that all the SIX metals / elements attain peak values during the Diwali day and this can be attributed mainly due to bursting of firecrackers.

**Table 6.5: Analyses Results of SIX Metals / Elements in ambient air in year 2016 in Delhi**

Locations	Period	Aluminium	Barium	Iron	Potassium	Sulphur	Strontium
		Note: <b>concentration (µg/m<sup>3</sup>)</b> ; BDL – below detection limit					
<b>Pitampura</b>	Pre-Diwali	BDL	0.268	1.282	4.847	5.229	0.012
	<b>Diwali</b>	<b>183.335</b>	<b>95.954</b>	<b>3.202</b>	<b>148.695</b>	<b>65.864</b>	<b>4.282</b>
	Post-Diwali	23.970	2.733	0.585	20.152	15.320	0.109
<b>CPCB-HQ</b>	Pre-Diwali	3.950	0.207	0.553	4.113	4.415	0.005
	<b>Diwali</b>	<b>166.190</b>	<b>60.925</b>	<b>2.025</b>	<b>128.967</b>	<b>56.852</b>	<b>2.840</b>
	Post-Diwali	4.856	0.223	0.611	7.168	13.748	BDL
<b>Janakpuri</b>	Pre-Diwali	4.318	0.094	0.769	3.717	4.985	BDL
	<b>Diwali</b>	<b>179.778</b>	<b>65.340</b>	<b>2.761</b>	<b>133.378</b>	<b>56.095</b>	<b>3.281</b>
	Post-Diwali	4.042	0.159	0.573	9.239	5.518	0.341
<b>Data source: CPCB Diwali 2016 (24 hourly average)</b>							

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## Pollution control measures of firecrackers - AMBIENT NOISE LEVELS

### 7.1 Hon'ble Supreme Court's concerns on NOISE from bursting of firecrackers

On high noise levels from firecrackers the Hon'ble Supreme Court of India expressed its concern as follows:

- “the need to control noise pollution arising out of bursting of firecrackers during Dusshera, Diwali and other festivals” ;
- ‘ban of the bursting of fire-crackers or any noise generating fireworks of high decibels to control the noise pollution’.
- There shall be a complete ban on bursting of sound emitting firecrackers between 10 p, to 6 am. It is not necessary to impose restrictions as to time of bursting of colour / light emitting firecrackers.

### 7.2 Noise impacts quality of life

The Central Government notified the Noise Pollution (Regulation and Control) Rules, 2000, vide S.O 123(E) dated 14.2.2000, under the Environment (Protection) Act, 1986. These Rules were amended in January 2010, under Rule#3 it states ‘*All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise.*’

### 7.3 Noise monitoring during Deepawali (Diwali) - CPCB's initiative

The bursting of firecrackers is a health hazard as it causes both air pollution (smoke) and noise pollution. Their excessive use has drawn public attention highlighting that it is violation of fundamental rights as enshrined in the constitution of India. To assess the noise pollution caused by bursting firecrackers during Deepawali the Central Pollution Control Board (CPCB) has been conducting ambient noise level monitoring during this festival regularly at various locations in



Delhi since **1993**, to find increased ambient noise level caused by intensive burning of crackers. The noise monitoring locations have been selected to cover almost all areas of Delhi. Subsequently this exercise was extended gradually to other cities where CPCB's field offices are established. In general the analyses showed that noise levels exceeded the ambient noise levels on the festive day exceeded at most of the locations.

The noise surveys (manual using sound level meters) conducted during Deepawali by CPCB offices (Headquarters – Delhi) and its field offices is summarised below for the years 2011 to 2015. It may be noted that the noise norms applicable during night hours have been exceeded during Deepawali (bursting crackers)

**Table 7.1: Noise Monitoring during Deepawali in DELHI  
(Years 2011-15) - (Note: Average Noise Level in dB (A) Leq.)**

Sl. No.	Location : Delhi	YEARS				
		2011	2012	2013	2014	2015
1.	AIIMS	76	76	81	80	-
2.	Connaught Place	69	69	74	80	-
3.	Mayur Vihar Ph-II	91	73	83	83	79
4.	Kamla Nagar	81	80	81	80	86
5.	Pitam Pura	75	75	73	71	74
6.	East Arjun Nagar	74	74	72	-	-
7.	Lajpat Nagar	81	81	79	-	76
8.	ITO/Pragati Maidan	71	71	69	-	-
9.	Dilshad Garden	80	78	80	-	-
10.	Janakpuri	-	-	-	78	79

**Table 7.2: Noise Monitoring during Deepawali in BANGALORE  
(Years 2011-15) - (Note: Average Noise Level in dB (A) Leq.)**

Sl. No.	Location : BANGALORE	Average Noise Level in dB (A) Leq.				
		2011	2012	2013	2014	2015
1.	R.T. Nagar	85	75	-	73	92
2.	Rajaji Nagar	86	80	85	88	-
3.	Raja Rajeshwari Nagar	74	68	79	69	69
4.	Nagarbhavi	-	-	80	-	-
5.	Malleswaram	78	76	-	-	-

**Table 7.3: Noise Monitoring during Deepawali in BHOPAL**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : BHOPAL	YEARS				
		2011	2012	2013	2014	2015
1.	Nehru Nagar	80	89	103	-	75
2.	TT Nagar	79	104	75	81	84
3.	Chola Road	-	-	-	89	67
4.	AG Colony	-	-	-	81	-

**Table 7.4: Noise Monitoring during Deepawali in LUCKNOW**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : LUCKNOW	YEARS				
		2011	2012	2013	2014	2015
1.	Indira Nagar	-	81	85	79	78
2.	Vikas Khand	-	66	66	56	70

**Table 7.5: Noise Monitoring during Deepawali in AGRA**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : AGRA	YEARS				
		2011	2012	2013	2014	2015
1.	Kamla Nagar	-	-	81	92	94
2.	Arjun Nagar	-	-	-	-	87

**Table 7.6: Noise Monitoring during Deepawali in VADODARA**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : VADODARA	YEARS				
		2011	2012	2013	2014	2015
1.	Fatehgunj	76	81	76	77	77
2.	M.S. University Campus	66	65	72	74	64
3.	Harinagar	88	82	78	73	80

**Table 7.7: Noise Monitoring during Deepawali in KOLKATTA**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : KOLKATTA	YEARS				
		2011	2012	2013	2014	2015
1.	North Kolkata	96	78	74	71	90
2.	South Kolkata	91	71	67	64	90

**Table 7.8: Noise Monitoring during Deepawali in SHILLONG**  
(Years 2011-15) (Note: Average Noise Level in dB (A) Leq.)

Sl. No.	Location : SHILLONG	YEARS				
		2011	2012	2013	2014	2015
1.	Lower Moti Nagar	-	71	-	71	49
2.	Upper Mawprem	-	88	86	84	88
3.	Fire Brigade	-	-	72	-	-
4.	Assam Bazar	-	-	-	86	-

The following link gives a report on ambient noise (manual) monitoring at Delhi and at CPCB's field offices and ambient air quality in DELHI during Diwali in year 2016 Web link: [http://cpcb.nic.in/Deepawali\\_2016.pdf](http://cpcb.nic.in/Deepawali_2016.pdf)

#### 7.4 CPCB's Real time noise monitoring network at a glance

- i. Criteria for selection of cities - cities having million plus population. Recognising NOISE as a serious environmental concern CPCB launched the **National Ambient Noise Monitoring Network** Programme in March 2010. The noise monitoring network shall be gradually expanded in phases covering more cities.
- ii. Locations of monitoring stations :  
The stations were installed as per the categorization of ambient noise zones by the states viz. Silence, Residential, Commercial and Industrial.
- iii. Cities covered: The cities presently covered are: Delhi, Kolkata, Mumbai (includes Navi Mumbai and Thane), Chennai, Bangalore, Lucknow and Hyderabad.
- iv. Phase-wise expansion of the network
  - a) Phase I of project launched in FY 2010 – 2011 covering @ 5 locations per city - 35 continuous noise monitoring stations established
  - b) Phase II launched in FY 2014-2015 covering the same cities @ in addition further five locations added per city - additional 35 continuous noise monitoring stations established.
  - c) Presently there @ 10 monitoring locations for noise monitoring per city, thus the total network strength is **70 stations as on 31<sup>st</sup> March 2016**. CPCB's Ambient Noise monitoring network (Phase I & Phase II) is given below.
- v. Noise Monitoring System (NMS): The noise monitoring network was designed for Real Time Continuous Ambient Noise monitoring.

- vi. Noise data interpretation: The sound level data from Real time Noise Monitoring Station is compared with Ambient Noise Standards to ascertain the extent of violation with respect to prescribed standards.

**Table 7.9: CPCB's Ambient Noise monitoring network**

Phase I / II / Zones Cities	Silence		Commercial		Residential		Industrial	
	I	II	I	II	I	II	I	II
Delhi	3	1	2	2	-	2	-	-
Mumbai, Navi Mumbai, Thane	2	-	3	1	-	1	-	3
Lucknow	2	1	1	2	1	1	1	1
Hyderabad	1	1	2	2	1	1	1	1
Bangalore	-	2	2	1	2	1	1	1
Chennai	1	1	2	2	1	2	1	-
Kolkata	1	1	2	1	1	2	1	1
Total ( 70 stations)	10	7	14	11	6	10	5	7
	<b>17</b>		<b>25</b>		<b>16</b>		<b>12</b>	

### 7.5 Consent under Air (Prevention & Control) Act 1981

In consultation with CPCB & State Pollution Control Boards (SPCBs) the Ministry of Environment, Forest and Climate Change (MoEFCC) developed the criteria of categorization of industrial sectors based on the Pollution Index which is a function of the emissions (air pollutants), effluents (water pollutants), hazardous wastes generated and consumption of resources. The FIRECRACKER industry is placed under RED category and the same has been adopted by SPCBs.

The SPCB grants consent to establish / operate under consent under section 21 of the Air (Prevention & Control) Act 1981 to firecracker manufacturing units in the State stipulating that units shall follow the safety procedures as suggested by PESO.

### 7.6 Issuance of permanent & temporary licenses for store / sale of firecrackers - DELHI

Entire Delhi is a restricted zone, licenses for store house / magazine is NOT permitted in DELHI. Delhi Govt. advt. (see below) issues licenses, at any time to permissible quantity to store fireworks applicable to temporary licenses holders is 600 kg and for permanent license it is 1500 kg. PESO is the authority on regulating issues / guidelines pertaining to firecrackers.

### 7.7 Fake firecrackers

It has been reported that in the past firecrackers from China have been brought into DELHI and were sold. These lack norms w.r.t. quality & safety. In year 2016 six cargo containers of Chinese firecrackers were seized in Delhi, the ministry of commerce and industry asked Directorate of Revenue Intelligence (DRI), Customs and state authorities to step up vigil against the banned crackers which suspected to be entering the Indian market through the ports under labels as toys, electronic goods or medical equipment far ahead of the festive season - Diwali. These firecrackers contain a banned explosive chemical - potassium chlorate. Delhi government formed 11 teams to crackdown on illegally imported crackers in year 2016. The firecracker made using potassium nitrate or sodium nitrate is several times costlier and 'less effective' than those made using **potassium chlorate**, hence crackers are being smuggled into the country.

There was presence of potassium chlorate in high levels at the accident site in Puttingal, where more than 100 people were killed and many were left injured in year 2016.

### 7.8 Prohibition on firecrackers w.r.t. safety & chemicals used in manufacture of firecrackers

FLYING crackers such rockets, chidias, aero-planes, fire-flies have been prohibited due to safety reasons in Delhi

Regarding prohibition of chemicals used in manufacture of firecrackers:

- a) Prohibited use of FIVE elements / metals in the manufacture of firecrackers – PESO has communicated that no forms of the Antimony, Lithium, Mercury, Arsenic and Lead shall be used in manufacturing firecrackers besides strontium chromate.
  
- b) Import of any explosives containing sulphur or sulphurate in admixture with any chlorate is banned vide notification GSR no 64(E) dated January 27, 1992 on the manufacture, possession, use, sale etc. of any explosives. However an exception has been made for import w.r.t. the following :
  1. In small quantities for scientific purposes
  2. For purpose of manufacturing heads of matches
  3. For use in toy amerces (paper caps for toy pistols)
  4. In percussion caps for use of railway fog signals

Chinese origin firecrackers generally contain the above banned chemicals therefore prohibited from import.

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## Pollution abatement measures - NOISE FROM FIRECRACKERS

### 8.1 Firecrackers noise standards in manufacturing stage under Environment

The Noise standards for fire-crackers were notified under the Environment (Protection) Rules, 1999 (Second Amendment) vide G.S.R. 682(E) dated the 5th October, 1999 and inserted at serial no. 89 of Schedule I. Subsequently these Rules were amended by the Environment (Protection) Rules, (Second Amendment) vide G.S.R. 640(E), dated the 16th October, 2006, under the Environment (Protection) Act, 1986) and are below. The Petroleum and Explosives Safety Organization (PESO) shall ensure implementation of these standards.

**A.** Applicable to sound producing fire crackers: Maroons, Atom bomb, Chinese crackers

- *“(i) The manufacture, sale or of firecrackers generating noise level exceeding 125 dB (AI) of 145 dB(C) pk at 4 meter distance from the point of bursting shall be prohibited.( Noise standards for fire crackers have been notified vide GSR No.682 (E) dated 5<sup>th</sup> October, 1999 under the Environmental (Protection) Act)*

*Note: dB(A): A - weighted impulse sound pressure in decibel; dB(C)pk: C- weighted peak sound pressure level in decibel.*

Note West Bengal Pollution Control Board (WBPCB) has stringent standard i.e. the approved sound limit is 90 dB (AI) at 5m distance from point of bursting (SPCBs may prescribe stringent limits).

**B.** Applicable to sound producing fire crackers: Garland firecrackers

- *(ii) For individual firecracker constituting the series (joined firecrackers), the above mentioned limit be reduced by  $5 \log_{10}(N)$  dB, where N= no. of crackers joined together.’*

### 8.2 Noise levels of firecrackers under Explosives Rules 2008

The fireworks are classified into the following categories depending upon the desired pyrotechnique effect:

- **Sound emitting fireworks.**

Fireworks with sound level not exceeding 125 dB (AI) or 145 dB (C) pk at 4 meters distance from the point of bursting.

For individual fire-cracker constituting the series (joined fire-crackers), the above mentioned limit be reduced by  $5 \log_{10}(N)$  dB, where N = number of crackers joined together;

- **Colour or light emitting fireworks.**

Such fireworks which emit colour or light and having sound level not exceeding 90 dB (AI) at 4 m distance from the point of bursting;

- **Display Fireworks.**

Any product of fireworks assembled at the site for the purpose of display including shell of diameter exceeding 25 mm, multiple shots or cake products of any diameter exceeding 25 nos., of shots in a product and lance network or other products as approved by the Chief Controller.”

### 8.3 Measurement of noise from firecrackers under Environment (Protection) Rules 1986

Measurement of noise from firecrackers is notified under Environment (Protection) Rules 1986. The broad requirements for measurement of noise from firecrackers are:

- (i) The measurement shall be made on hard concrete surface of minimum 5 metre diameter or equivalent.
- (ii) The measurement shall be made in free field conditions i.e. there shall not be any reflecting surface upto 15 metres distance from the point of bursting.
- (iii) The measurement shall be made with an approved sound level meter.

### 8.4 Procedure for testing firecracker noise

The ‘*Procedure for testing noise firecrackers for compliance of Noise Standards*’ (applicable to firecrackers - maroons, atom bomb, chinese crackers)

- a) INSTRUMENTATION: The instrument system, including the microphones and preamplifier system, shall meet the requirements for a type 1 instrument specified in IEC 60651 or IS 9779. The microphone shall be of free field type. The upper range of the instrument shall be up to 170 dB<sub>pk</sub>, preferably by using ¼ inch microphone. The instrument shall have A-weighted maximum impulse hold facility in case the measurement is done in dB(AI) or C-weighted peak hold facility in case the measurement is done in dB (C)<sub>pk</sub>.

- b) **SETUP:** The measurements shall be made on a smooth, hard and horizontal concrete surface of minimum 5 m diameter or equivalent. The measurements shall be made in free field conditions i.e. there shall not be any reflecting surface within 15 m distance from the point of bursting. The microphones shall be fitted on tripods, 1.3 m above the ground, with axis parallel to the surface of the test site and pointing to the firing position. The microphone shall be at 4m, horizontally, from the point of bursting. The microphone shall be connected to the instrument through preamplifier and cable. The wind velocity shall not be more than 5 m/s at the time of testing, when measured at a height of 1.5 m above the ground level. The relative humidity in air shall, preferably, not be more than 60% at the time of measurement.
- c) **CONDITIONING:** The firecracker samples shall be pre-conditioned to remove moisture, by heating at 50<sup>o</sup> C for minimum 24 hours. The sample should be cooled in a desiccator immediately after thermal conditioning. The firecracker samples shall be taken to the field in the desiccator or in a plastic bag to avoid absorption of moisture. The samples should be taken out of the desiccator / bag, one by one for testing.
- d) **AGE:** The sound generating potential of firecrackers reduces with time. In case the measurement is being done to test compliance at the manufacturing stage, the age of firecrackers (period after manufacturing) shall not be more than 3 months.
- e) **SAMPLING:** In order to ensure the randomness of selection, procedure given in IS 4905 shall be followed. For testing compliance of a firework category, at the manufacturing stage, the following sampling ratio shall be adopted (See below) for testing compliance of a category of firework, at the point of sale, minimum 10 samples of the firework category shall be tested.

**Table 8.1: Procedure for testing firecrackers - Maroons, Atom bomb, Chinese crackers**

<b>Category of Firework</b>	<b>No. of packets / bundles to be selected from a lot</b>	<b>No. of crackers to be tested</b>
Maroons	Min. 1%	0.1 % of total number in the lot (min. 10 samples to be tested)
Atom bomb	Min. 1%	0.1 % of total number in the lot (min. 10 samples to be tested)
Chinese crackers	Min. 1%	0.05 % of total number in the lot (min. 10 samples to be tested)*

\* This is irrespective of the number of crackers in a lari.



- f) **TEST PROCEDURE:** The velocity and relative humidity shall be checked. These shall not exceed the values given above. The instrument shall be calibrated before the test. The calibration shall be checked after the test. The deviation shall not be more than 1 dB (A).  
The first sample shall be taken out of the desiccator / plastic bag and placed at the centre of the test area.  
Ignition shall be applied to the sample.  
The sound level shall be recorded either in dB(AI) or dB (C)<sub>pk</sub>.  
The sound level of all the samples shall be determined by following the steps 3 to 5.

The degree of compliance shall be minimum 90% i.e. not more than 1 out of every 10 samples tested, shall fail. If the degree of compliance is less than 90%, the lot shall be considered to have failed.

### **8.5 Noise levels for firecrackers applicable for export**

The Noise levels for firecrackers for export are notified under Environment (Protection) Rules 1986 (inserted on 16-10-2006). The five crackers for the purpose of export shall comply with following conditions, namely:-

- (i) The manufacture shall have an export order;
- (ii) The firecrackers shall conform to the level prescribed in the country to which it is exported;
- (iii) They shall have a different packing colour code, and
- (iv) There shall be a declaration on the box “not for sale in India” or “only for export in the counties”.

### **8.6 Testing noise levels of Firecrackers procured from Delhi market – CPCB’s initiative**

The noise levels of fire-cracker samples procured by CPCB from the local markets in Delhi are tested by National Physical Laboratory (NPL), New Delhi. The objective of the study is to assess whether the noise level of fire-crackers available in the market meet the prescribed noise limits. Results of the analyses from FY 2007 – 2009 to FY 2015 to 2016 are given in the Tables below w.r.t. compliance of norm 125 dB(AI) and compliance of norm 145 dB (C)<sub>pk</sub> @ 4 m distance from the point of bursting. Non-compliance of noise levels were observed (See Tables below).

**Table 8.2: Noise Level produced by various firecrackers (2008-09)**

Sl. No.	Name of fire – cracker	Fire-cracker Brand/ Manufacture	Generated Noise Level		Remarks
			dB(C)pk	dB(AI)	
1.	Horse	Sri Kaliswari	151±3	126±2	<p><u>Compliance of norm 125 dB(AI):</u> Noise levels exceeded the specified limits in majority of the crackers tested</p> <p><u>Compliance of norm 145 dB (C)-pk @ 4 m distance from the point of bursting :</u> Except for one case, noise levels exceeded the specified limits in all the crackers tested</p> <p>* Two Samples</p>
2.	Laxmi Bomb	The Rathnaa	148±3	124±2	
3.	Nagin Crackers (128 Lari)*	Sri Kaliswari	149	125	
4.	Square Foils	Sri Rajeswari	153±3	128±2	
5.	Square Green	Sri Kaliswari	158±1	129±1	
6.	Timing Bullet	The Rathnaa	154±1	128±1	
7.	Victory Green Bomb	The Rathnaa	153±4	127±2	
8.	Bullet	Sri Kaliswari	155±2	129±1	
9.	Hydro Green	Sri Kaliswari	157±3	129±1	
10.	Hydro Green	The Coronation	151±6	125±5	
11.	Dolphin Bullet Bomb	Sri Mahalaxmi	155±2	128±1	
12.	Classic Bomb Green	The Rathnaa	157±4	128±1	
13.	Titan Bomb Foils	Aravind	161±6	128±1	
14.	Nazi Atom Bomb	Naya Cornation	161±4	128±2	
15.	Glittering Bullet	Sri Rajeswari	134±3	112±2	
16.	Classic Bomb Green	Jai Gangai	160±4	128±2	

**Table 8.3: Noise Level produced by various firecrackers (2009-10)**

Sl. No.	Name of fire-cracker	Fire-cracker Brand / Manufacture	Generated Noise Level		Remark
			dB(C)pk	dB(AI)	
1.	Tri Colour Fountain	Bluejay/Sri Durkesh	101±1	89±1	<p><u>Compliance of norm 125 dB(AI):</u> Noise levels exceeded the specified limits</p>
2.	Rocket	Cock/Sri Kaliswari	126±3	106±3	
3.	Flower Pots Deluxe	Cock/Sri	97±4	85±1	

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

		Kaliswari			<p>in majority of the crackers tested</p> <p><u>Compliance of norm 145 dB (C)-pk @ 4 m distance from the point of bursting:</u> Noise levels exceeded the specified limits in majority of the crackers tested</p> <p>* Single piece</p>
4.	Bijili Crakers	Cock/Sri Kaliswari	137±4	118±2	
5.	12 Star*	Bluejay/Sri Durkesh	141	122	
6.	Whistling Wheel	Cock/Sri Kaliswari	116±1	109±1	
7.	Sky Whistling Wheel	Cock/Sri Kaliswari	118±2	110±1	
8.	Flower Pots Big Green	Cock/Sri Kaliswari	96±2	84±2	
9.	Hydro Foiled	Cock/Sri Kaliswari	158±2	128±1	
10.	Mini Bullet	Cock/Sri Kaliswari	153±5	127±4	
11.	Bullet	Cock/Sri Kaliswari	157±2	128±1	
12.	Parrot	Cock/Sri Kaliswari	152±2	128±1	
13.	Terminator Bomb	Pen/Jai Bhavani	157±4	128±1	
14.	Nazi Green	Cornation/The Coronation	164±2	129±1	
15.	Hydro Green	Duck/Sri Rajeshwari	155±4	128±2	
16.	Classic Green	Azad/Azad Pyrotech	162±3	129±1	
17.	Dynamite Premium	Golden Light/Sahara	162±3	129±1	
18.	Hydro Green	Cornation / Naya Carnation	159±1	129±1	

**Table 8.4: Noise Level produced by various firecracker (2010-11)**

Sl. No.	Name of fire-cracker	Fire-cracker Brand/ Manufacture	Generated Noise Level		Remark
			dB(C)pk	dB(AI)	
1.	King of Kingo Foils Deluxe/Golden Eagle	Vadivel Pyrotechs	160±2	129±1	Compliance of norm 125 dB(AI): Noise levels exceeded the specified limits in majority of the crackers tested
2.	Thunder Bombs/Peacock	Standard	160±2	129±1	
3.	Classic Foils/Golden Eagle	Vadivel Pyrotechs	160±2	129±1	
4.	Atom Bomb/Arrow	Sri Sudharsan	156±2	127±1	
5.	Nazi Green/Cornation	Naya Carnation	163±1	129±1	
6.	Hydro Bomb/Indradhanush	Sathies	159±1	128±1	
7.	Atom Bomb/Fox	The Victoria	159±1	129±1	
8.	Super Buller/ Cornation	The Coronation	150±3	125±2	
9.	Two Sound /Grauda	Classic	154±2	128±1	
10.	One Sound/Golden Eagle	Vadivel Pyrotechs	154±2	128±1	
11.	One Sound Electric Cracker/Bird	Kuruvi / Parani	146±3	123±3	Compliance of norm 145 dB (C)- pk @ 4 m distance from the point of bursting: Noise levels exceeded the specified limits in all the crackers tested
12.	Flying Horse (28 Lari)	Jai Manoj	147	124	
13.	Hydro Foiled/Cock	Sri Kaliswari	160±2	129±1	
14.	Mini Bullet/Cock	Sri Kaliswari	153±2	127±2	
15.	Hydro Green/Cock	Sri Kaliswari	152±7	127±4	
16.	Kamal Nayan (28 Lari)	Sri Lakshmi Shankar	146	123	
17.	Classic Foil/Lotus	Sri Kumar	155±3	127±1	
18.	Magic Fountain Mighty Atom/Cock	Sri Kaliswari	158±1	129±1	

**Table 8.5: Noise Level produced by various firecracker (2011-12)**

Sl. No.	Name of fire-cracker	Fire-cracker Brand/ Manufacture	Generated Noise Level		Remark
			dB(C)pk	dB(AI)	
1.	Classic Foil/Lotus	Sri Kumar Fireworks	155±4	127±3	<u>Compliance of norm 125 dB(AI):</u> Except for one case the noise levels were exceeded the specified limits in all the crackers tested <u>Compliance of norm 145 dB (C)- pk @ 4 m distance from the point of bursting :</u> Noise levels exceeded the specified limits in all the crackers tested
2.	Classic Bomb/Pigeon	Shelva Vinayaga Fireworks Sivakasi	153±2	127±2	
3.	Laila Majnu/Krishna	Sri Krishna Fireworks	156±2	129±1	
4.	Hydrogen Bomb/Krishna	Sri Haridrishan Fireworks	158±3	129±1	
5.	Bullet Bombs/Peacock	Standard Fireworks	155±1	128±1	
6.	Atom Bomb Foils/Krishan	Sri Krishna Fireworks	157±3	129±1	
7.	Laxmi/Krishan	Sri Haridrishan Fireworks	153±2	128±1	
8.	Kaliswari/Cock	Sri Kaliswari Fireworks	152±3	127±1	
9.	Electric Cracker/ Krishan	Sri Krishna Fireworks	150±3	126±2	
10.	Turkey/Ball Brand (1 Pack)	Santhana Mari Fireworks	150	122	

**Table 8.6: Noise Level produced by various firecracker (2012-13)**

Sl. No.	Name of fire-cracker	Fire-cracker Brand/ Manufacture	Generated Noise Level		Remark
			dB(C)pk	dB(AI)	
1.	Terminator Bomb Green	Cock/ Shri Jaibhawani	141±2	129±2	<u>Compliance of norm 125 dB(AI) :</u> Noise levels exceeded the specified limits in majority of the crackers tested <u>Compliance of norm 145 dB (C)- pk @ 4 m distance from the point of bursting :</u> Noise levels complied the specified limits in all crackers tested
2.	Magic Fountain Mighty Atom	Pen/ Shri Kaliswari	142±1	128±2	
3.	Classic Bomb	Raja/ Rajesh	142±1	129±1	
4.	Hydro Foiled	Cock/ Shri Kaliswari	142±1	128±1	
5.	Liberty	Kamal Nayan /Sri Lakshmi Shankar	139±1	122±1	
6.	Mini Bullet	Cock/ Shri Kaliswari	140±1	128±1	
7.	Automatic Rocket	Cock/ Shri Kaliswari	126	116	
8.	Apsara Sky Shot	Fox/ Victoriya	123±2	118±1	
9.	Hydrogen Green	Cock/ Sri Rajeshwari	141±2	128±1	
10.	Classic Foil	Lotus/ Sri Kumar	139±1	122±3	

**Table 8.7: Noise Level produced by various firecracker (2013-14)**

Sl. No.	Name of fire-cracker	Fire-cracker Brand/ Manufacture	Generated Noise Level		Remark
			dB(C)pk	dB(AI)	
1.	Single Shot	402/Jay Ganesh Krishna	141±2	127±2	Compliance of <u>norm 125 dB(AI)</u> : Noise levels exceeded the specified limits in majority of the crackers tested
2.	Single Shot	Krishna/Sri Hari Krishna	145±3	127±1	
3.	Mini Bullet	Coronation/Coronation	145±3	124±2	
4.	Chit Phut Delux	Vanitha/Vanitha	126±4	109±4	
5.	Hydrogen Bomb	Krishna/Sri Hari Krishna	147±3	129±1	
6.	Rangoli	Peacock/Standard	127±3	108±2	
7.	Hydrogen Green	Cock/Shari Kaliswari	148±1	129±1	
8.	Hydrogen Green	Duck/Shri Rajeshawary	147±2	128±2	Compliance of <u>norm 145 dB (C)- pk @ 4 m distance from the point of bursting</u> : Except for few cases the noise levels complied the specified limits in majority of the crackers tested
9.	Nazi Green	Coronation/Naya Coronation	157±1	131±2	
10.	Classic King Size	Sun/Sun	142±3	128±3	

**Table 8.8: Noise Level produced by various firecracker (2014-15)**

Sl. No.	Name of fire cracker	Fire cracker Brand/ Manufacture	Generated Noise Level		Remarks
			dB(C)pk	dB(AI)	
1.	Hydro Green	Duck/Sri Rajeswari	137±5	129±1	Compliance of <u>norm 125 dB(AI)</u> : Noise levels were exceeded the specified limits in
2.	“Standard” 7 Shots	Peacock/Standard	120±5	116±4	
3.	Mini Bullets	Cock/Shri Kalishwari	137±2	128±1	
4.	Turkey Electric Crackers	Sun/Sun	133±3	123±2	

**Status of Pollution Abatement Measures:  
Firecrackers (patakas)**

5.	Square Green	Duck/Sri Rajeswari	139±1	130±1	some of the crackers tested  <u>Compliance of norm 145 dB (C)- pk @ 4 m distance from the point of bursting :</u> Noise levels complied the specified limits in all the crackers tested
6.	“Standard” Rang Goli	Peacock/Standard	125±2	112±3	
7.	Classic King Size Green	Sun Brand/Sun	144±2	130±1	
8.	Cornation Mini Bullets	Cornation/Cornation	134±2	125±1	
9.	Magic Fountain Mighty Atom	Cock/Shri Kaliswari	140±2	130±1	
10	Automatic Rocket	Cock/Shri Kaliswari	119±2	112±2	

**Table 8.9: Noise Level produced by various firecracker (2015-16)**

Sl. No.	Name of fire cracker	Fire cracker Brand/ Manufacture	Generated Noise Level		Remarks
			dB(C)pk	dB(AI)	
1.	Timing Flash	Carnation /Carnation Fireworks	141±2	129±2	<u>Compliance of norm 125 dB(AI) :</u>
2.	Atom Bomb Green	Sun Brand /Sun Fire Works	139±3	127±2	Noise levels were exceeded
3.	Atom Bomb Foils	Sun Brand /Sun Fire Works	140±3	128±3	the specified limits in all the crackers tested
4.	Hydro Bomb (Hydro Green)	Carnation /Naya Carnation Fire works	142±4	130±4	
5.	Bomb Foils	Sun Brand /Sun Fire Works	139±3	127±2	<u>Compliance of norm 145 dB (C)- pk @ 4 m distance from the point of bursting :</u>
6.	Atom Bomb	Sun Brand /Sun Fire Works	141±3	129±2	Noise levels complied the specified limits in all the crackers tested
7.	Hydro Bomb Foils	Sun Brand /Sun Fire Works	139±1	127±2	
8.	Big Bullet Bomb	Khushi / Gulson Fire works	138±2	127±2	
9.	Mighty Atom Flower	Maharaja Brand /Sri Shiv Sankar Fireworks	138±1	127±2	
10	Sun 100 Wala	Sun Brand /Sun Fire Works	137±3	126±1	.

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## Public Display of Fireworks – an overview

### 9.1 Public display of fireworks is significant in KERALA

Bursting firecrackers on festive occasions are not new to any state of the country, however the **‘public display’** of fireworks is more frequent in Kerala. In Kerala, ‘POORAM’ (see photo) is a Hindu ritual festival wherein caparisoned elephants are led in an organized procession. There are many festivals in the state that are celebrated on such lines ex. Thrissur pooram, Nenmara Vallangi Vela, Arattupuzha pooram, Chinakathur pooram etc. The most spectacular show during the ‘Pooram’ celebration is the magnificent and thunderous display of fireworks that takes place late night and ends just before dawn (typically before 4:00 am). The fireworks (Vedikketu) show is enjoyed by thousands of people gathered from various parts of the state, it is a unique class of its own of Kerala temple festivals.



As per reports the annual Vela festival, celebrated by Nemmara and Vallangi villages after the paddy harvest, is famous for its display of fireworks during Nenmara Vallangi Vela festival. The festival is followed by a magnificent display of fireworks, marking the grand finale of the festival. The landscape adds to the overall effects of the fireworks display. For example in the Nenmara Vallangi Vela, the peculiar landscape (of being a low valley surrounded by many hills) adds extra reverberation and reinforcement to the sounds produced.

### 9.2 Accidents due to ‘public display’ of fireworks

Deaths due to *public display* of fireworks is significant, particularly in the State of Kerala. The high incidence of firework accidents are mainly due to the large number of ‘pooram’ and ‘vela’ festivals in which fireworks display is a major attraction. As per the data available with the Thrissur-based Heritage Animal Task Force, about 451 persons were killed in year 2013, similar accidents have happened in the State during the past three years. A brief list of accidents arising from bursting firecrackers during festivals in Kerala is given below.



- i. The cracker blast at the premises of Sabarimala Lord Ayyappa temple in 1952 claimed at least 68 lives.
- ii. As many as 20 people had been killed in another cracker blast during a church festival in Thrissur district in 1984
- iii. 26 people had died during a blast in the storehouse of crackers at a temple in Malanada in Kollam in 1990.
- iv. Seven people had been killed during another explosion at the storehouse where firecrackers had been kept for the famous Thrissur Pooram festival in 2006.
- v. In April 2013 accident happened during Nenmara-Vallangi Vela festival on a Saturday. Over 25 people, including two women civil police officers, sustained injuries apart from the death of a person in subsequent commotion.

### **9.3 Case study - Unauthorised public display of fireworks in Puttingal Devi Temple Tragedy in Kerala (10<sup>th</sup> April 2016)**

1. At least 100 people were killed and nearly 400 injured in the devastating fire during an unauthorised display of fireworks on 10<sup>th</sup> April 2016. The fireworks, had started at midnight as part of an annual festival, thousands of people had gathered to witness it.

The devastating fire engulfed the 100- year-old Puttingal Devi Temple complex near Kollam where fireworks show is part of the annual festival. The temple complex is around 70 km from the state capital Thiruvananthapuram.



The mishap occurred as sparks of the fireworks fell on the store room 'Kambapura' wherein the fire crackers kept there exploded with a deafening noise. The blaze spread quickly trapping the devotees within the complex. Charred bodies and human remains were strewn around the temple complex after the fire tragedy. The explosions also ripped chunks of concrete and plaster from the temple and nearby buildings which fell on people killing some on the spot and wounding many others.

2. General concerns on public display of fireworks

The main causes for tragedy at Puttingal Devi Temple complex near Kollam, Kerala as per newspaper reports are:

- a) The temple Devaswom Board had sought permission for public display of fireworks in the Puttingal temple from the Additional District Magistrate however the permission was denied to carry out fireworks exhibition. The Dewasom Building was destroyed in the fire.



- b) The fireworks was a competition between two parties on proving who was better in displaying fireworks.
- c) According to the police the area was unfit for display of fireworks exhibition because it is surrounded by houses (residential area). The residents of the area had protested on earlier occasions too.

A judicial probe by a retired high court judge was ordered by the state government along with an investigation by Crime Branch into the tragedy.

3. General apprehensions on public display of fireworks are listed below:

- a) On noise levels:

There are apprehensions that in some of the festivals, the organisers use fireworks that have the effect of dynamites i.e. produce high decibel sound levels. Dynamites and 'gundu' were prohibited in the State by the High Court in 2003. In 2009, in another order, the High Court imposed restrictions on the sound level of explosions (high decibel crackers).



Besides '*Accidents due to 'public display' of fireworks*' , at some festival venues it has been reported that explosives go off in the holes dug in the ground resulting in large masses of earth falling on the assembled people sometimes injuring them.

- b) On composition of firecrackers :

- a. It was reported that the use of **potassium chlorate** instead potassium nitrate in making the crackers had also contributed to the incident.

- b. As per the law, dynamites are banned for use in public display in fireworks. It is reported banned chemicals are being used in fireworks manufacture. (Ref. The Hindu , April 4<sup>th</sup> 2016 & Palakkad Edition, April 5, 2013)
- c) Permits, Storage & permissible quantities of fireworks to conduct public display of fireworks:
  - a. Though the local administration are authorised to permit public display of fireworks however for compliance, enforcement needs to be further strengthened.
  - b. On occasions organisers do not take permission to display fireworks if they do take permissions, the conditions are flouted. In some cases it was reported that fireworks manufacturing licensees were allowed to possess only 15 kg of explosives but some of them stored 50 to 60 tonnes of ‘explosives’.
  - c. There instances reported that the manufacturers use sub-contractors to store huge quantity of fireworks to make profits.

#### **9.4 Definition of “public place” under Noise Pollution (Regulation & Control) Rules, 2000**

Under Rule #2(i) of Noise Pollution (Regulation and Control) Rules, 2000 “public place” means any place to which the public have access, whether as of right or not, and includes auditorium, hotels, public waiting rooms, convention centres, public offices, shopping malls, cinema halls, educational institutions, libraries, open grounds and the like which are visited by general public;

#### **9.5 Public fireworks display under Explosives Rules, 2008**

1. Classification of fireworks depending on pyro technique effect (Rule 4)  
Under the Explosives Rules, 2008 the fireworks are classified into the following categories depending upon the desired pyro-technique effect:
  - (i) Sound emitting fireworks
  - (ii) Colour or light emitting fireworks
  - (iii) Display Fireworks
2. Sub Rule (3) the fireworks are classified as following depending upon the desired pyrotechnique effect:
  - a. Sound emitting fireworks
  - b. Colour or light emitting fireworks
  - c. Display Fireworks.— Any product of fireworks assembled at the site for the purpose of display including shell of diameter exceeding 25 mm,

multiple shots or cake products of any diameter exceeding 25 nos., of shots in a product and lance network or other products as approved by the Chief Controller;

3. Under Schedule I Part I: Class 7 assigned to –Fireworks

This class has four divisions, namely, the Division 2 fireworks comprises of three sub-divisions. The sub-division 3 of Division 2 fireworks comprises such fireworks, which are assembled at site purely for the purpose of display.

4. Some important definitions

Definitions under Rule 2 sub-rule

- i. (19) defines “display fireworks” means *a group of authorised manufactured fireworks assembled at site, solely for the purpose of display;*
- ii. (24) “fireworks” means *low hazard explosive comprising of any composition or device manufactured with a view to produce coloured fire or flame, light effect, sound effect, smoke effect (coloured or natural), or combination of such effects and includes fog-signals, fuses, rockets, shells, percussion caps;*
- iii. (25) “fireworks composition” means *any chemical compound or mechanically mixed preparation of an explosive or inflammable substance that is used for the purpose of making manufactured fireworks and is not included in any other class of explosives, and includes any star or coloured fire composition;*

For further information refer Explosives Rules, 2008 Public fireworks display

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## Initiatives in Mass Awareness

### 10.1 Display of real time noise data

Recognising NOISE as a serious environmental concern CPCB launched the *National Ambient Noise Monitoring Network* Programme in March 2010. The following are measures to disseminate information to public:

- i. Urban noise levels initiative: Noise Monitoring System (NMS)  
The noise monitoring network established by CPCB was designed for Real Time Continuous Ambient Noise monitoring.
- ii. LED display screens  
The noise monitoring network stations was designed with display features for public awareness. For display of noise data: 35 LED display screens installed, Three additional display LED screens at Delhi: CPCB (two places) & MoEF&CC  
Web display: CPCB's Website noise data display: Noise Monitoring System (NMS)

Noise data is available to public on-line through websites (CPCB, SPCBs) and also NOISE PORTAL - [cpcbnoise.com](http://cpcbnoise.com)

### 10.2 Reports on NOISE during Deepawali

Most of the noise level surveys conducted during Deepawali are monitored at various locations in cities where CPCB's Regional Offices are established. The results are provided in the Annual Reports, besides the following reports have also been brought out:

- i. Status of Ambient Noise pollution during Deepawali in India (NANMN/1/2015-16)
- ii. Ambient Air and Noise Pollution Levels - Deepawali 2008
- iii. Ambient Noise Level and Status in Delhi During Deepawali Festival Days (noise survey: 1999-2002) under Comprehensive Urban Pollution Series (CUPS)
- iv. Ambient Noise Level Status in Delhi during Deepawali (noise survey: 1995 & 1999) under Comprehensive Urban Pollution Series (CUPS)
- v. A Report on Ambient Noise Level and Air Pollution During Deepawali Festival in Delhi (noise survey : 1997-98) under Comprehensive Urban Pollution

Series (CUPS) Ambient Noise Level Survey in Delhi on the Occasion of Deepawali Festival (noise survey : 1993-95) under Comprehensive Urban Pollution Series (CUPS)

Note, this the first status report addressing the environmental issues on Firecrackers viz. noise & emissions

### 10.3 Mass awareness in print media - CPCB & PESO

CPCB's releases advertisements each during Deepawali in leading national and local newspapers (languages: Hindi, Urdu, Punjabi, Kannada, Bengali, Marathi, Gujarati) on the occasion of Deepawali. (see Table & advt. below)

**Table 10.1: Mass Awareness (print media) – DIWALI 2015**

City	Language	Newspaper (daily)	
<b>Delhi</b>	Hindi	1.	Dainik Jagran
		2.	Navbharat Times
		3.	Amar Ujala
		4.	Hindustan
		5.	Punjab Kesari
	English	1.	The Hindustan Times
		2.	The Pioneer
		3.	Indian Express
		4.	The Time of India
		5.	Mail Today
6.		Millennium Post	
Urdu	1.	Jadid Khabar	
Punjabi	1.	Chandikala	
<b>Bengaluru</b>	Hindi	Rajasthan Patrika	
	English	New Indian Express	
		Deccan Herald	
Kannada	Prajavani		
<b>Kolkata</b>	Hindi	Anand Bazar Patrika	
	Bengali	Telegraph	
<b>Vadodara</b>	Marathi	Lokmat	
	Gujarati	Gujarat Samachar	
<b>Bhopal</b>	Hindi	Dainik Bhaskar	
<b>Lucknow</b>	Hindi	Dainik Jagran	
	English	Times of India	

Fig. 10.1 Print media: CPCB's initiatives

**HAPPY DIWALI**  
**FESTIVAL OF LIGHT**  
**Appeal**  
 Central Pollution Control Board  
 Protect Environment & Expressing by

**Saying NO to NOISE**  
**Saying NO to SMOKE**  
**Saying NO to POLLUTION**

Bursting sound emitting fire-crackers between 10:00 PM and 6:00 AM is banned.  
 Violation of the above may attract action under the provisions of the Environment Protection Act, 1986.  
 Issued in public interest by:

**CENTRAL POLLUTION CONTROL BOARD**  
 (Ministry of Environment & Forests, Govt. of India)  
 Parivesh Bhawan, East Arjun Nagar, Delhi - 110032  
 Ph: 011-22301932, 43102030, Website: cpcb.nic.in

**“पर्यावरण मित्र दीपावली मनाएं”**

पटाखों से शोर-गुल और वायु प्रदूषण होने के कारण हमारे पर्यावरण को नुकसान होता है एवं स्वास्थ्य पर प्रतिकूल प्रभाव पड़ता है। आतिशबाजी से धुआं, सूक्ष्म जहरीले कण और रसायन निकलता है जिससे निम्नलिखित समस्याएं होती हैं:

- सांस की बीमारी बढ़ जाती है
- आंख और शरीर के दूसरे अंगों को नुकसान होता है
- सुनने की क्षमता प्रभावित होती है
- अनिद्रा, उच्च रक्तचाप, तनाव, धरकण आदि होने लगती है
- पालतू पशुओं सहित अन्य पशुओं में तनाव


पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय एवं केंद्रीय प्रदूषण नियंत्रण बोर्ड लोगों को अपना जीवन बचाते हुए एवं पर्यावरण का ध्यान रखते हुए दीपावली का उत्सव मनाने का अनुरोध करता है।

**केंद्रीय प्रदूषण नियंत्रण बोर्ड**  
 पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय  
 भारत सरकार

davp 13113/13/0044/1516

Fig. 10.2 Print media: PESO

...DF lost to an independent candidate, Sheeba ...ash, who was supported ... the UDF, by just 65 votes. ... Kanathumchira ward, ... made a score on a margin of three votes, beating all expectations. ... The UDF secured 16 wards in Matool losing one to an independent candidate.



LDF candidates during victory procession in Tirur on Saturday

pality in the district ... ing 21 seats from ... seats.

... TO FRIDAY ... 5667770

**ANNEXURE - I**

**GOVERNMENT OF INDIA ■ MINISTRY OF COMMERCE & INDUSTRY**  
**PETROLEUM & EXPLOSIVES SAFETY ORGANISATION (PESO)**  
 (Formerly Department of Explosives)

**WARNING**

It is brought to the notice of all Public that Government of India vide Notification No. G.S.R.682(E), dated 5.10.1999 has prohibited the manufacture, sale or use of Fire Crackers generating noise level exceeding 125 dB(A1) including jointed fire crackers (Garland). The manufacture, sale or use of such fire crackers is illegal and anyone found violating is liable for necessary action under the Statutory Rules.

For safety during Deepawali festival, observe the following precautions:-

**DO'S**

- ❖ Buy the fireworks from the reliable sellers possessing licence.
- ❖ Always an adult should supervise the use of fireworks.
- ❖ Safety precautions marked on the fireworks should be strictly followed.
- ❖ Use a candle or an agarbathi to ignite the fireworks.
- ❖ Always keep a bucket of water at hand to extinguish an incipient fire.
- ❖ Aerial fireworks should be used in a safe landing zone.
- ❖ Dispose off fireworks properly by soaking them in water.

**DON'T'S**

- ❖ Manufacture, Sale or use of fireworks generating noise exceeding 125 dB (A1) or 145 PK at 4 mtr. distance from the point of bursting is prohibited. For individual fire cracker constituting the series (joint crackers) the above-mentioned limit to be reduced by 5 log<sub>10</sub> (N) dB where N is equal the number of crackers jointed together.
- ❖ Do not burst sound emitting firecracker between 10 p.m. and 6 a.m.
- ❖ Never ignite fireworks while holding them. Keep the fireworks at ground level, ignite and walk away.
- ❖ Don't light fireworks by keeping them inside any containers.
- ❖ Never ignite aerial fireworks where overhead obstructions, viz. trees, leaves, wires, etc. may distract the trajectory into open air space.
- ❖ Never ignite aerial fireworks close to a building, so as to avoid entry of fireworks through the door, window, etc., which may cause fire inside the building.
- ❖ Never use fireworks inside the house.
- ❖ Do not use fireworks on the public thoroughfare.
- ❖ Never experiment or make your own fireworks.
- ❖ Never re-light a "dud" firework (wait 15 to 20 minutes and then soak it in a bucket of water).
- ❖ Do not use spurious/illegal fireworks.
- ❖ Do not allow children to use fireworks alone.

**Government of India**  
**Petroleum & Explosives Safety Organisation (PESO)**  
 (Formerly Department of Explosives)  
 Issued in the Interest of Public Safety.

Civil Engineering  
 Electronics and Commu  
 Computer Science and I  
 Automobile Engineering  
 Instrumentation Enginee  
 Petrochemical Technica  
 Physics  
 Management Studies  
 Prescribed application  
 and instructions to th  
 field of specialization  
<http://www.annauniv.e>  
 enclosing a Demand  
 candidates) dated not ex  
 the Registrar, Anna Univ  
**Candidates, who have**  
 Professor as per the ac  
 need not apply again,  
 submit information  
<http://www.annauniv.e>  
 Last date for the receipt c  
 DIPPR/1529/DISPLAY/201

**रामन**  
**Raman**  
 रैनलूर

रामन अनुसंधान  
 अनुसंधान में संल  
 स्वशास्त्री संस्थान, र  
 आमंत्रित करता है।  
 "http://www.rr.  
 1. सहायक प्रशास  
 39,100 + ग्रेड पे  
 6,600  
 2. अनुसंधान सहयो  
 पे 5,400  
 3. कार्यालय सहाय  
 The Raman R.  
 autonomous ins  
 sciences funded  
 applications from  
 posts. For det  
 "http://www.rr.  
 1. Assistant Adn  
 Rs. 15,600-39,10  
 Rs. 15,600-39,10  
 2. Research Ass  
 39,100 + Grade P  
 3. Office Assista

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## Harmonization of Standards on Firecrackers - BIS & ISO

### 11.1 UN numbers on Firecrackers - global overview

Fireworks are any composition or devices designed to produce visible and/or audible effects by combustion, while meeting the definitions of:

- a. “*consumer fireworks*”.
  - b. “professional or *display fireworks*”
- i. Consumer fireworks: Consumer fireworks are small fireworks designed to produce some effects, such as smoke, sparks, noise, color, and flames, by combustion. They have generally weaker explosive properties than professional items. Consumer fireworks are available on sale to the general public and are used in marriages, parties or other celebration events. In consumer fireworks, some basic components, such as oxidizing agents, fuels, binders, colorants and/or metallic salts, are required to obtain the characteristic pyrotechnic effects.
  - ii. Professional or display fireworks are large items commonly used during festivals and celebrations. They are handled and ignited by qualified workers.

Explosives and fireworks are classified using procedures established by the United Nations (UN) within the framework of international transport. The EU Directive provides a wide framework in which the European countries adopt measures.

The UN proposed UN numbers that exactly identify hazardous substances and articles, regarding fireworks are:

- UN0336 identifies with *consumer fireworks*
- UN0035 covers *display fireworks*.

### 11.2 Noise abatement measures from fireworks – Global overview

Most countries have strict laws, continually under revision, trying to control their citizens' handling of all kind of explosive devices, including firework devices. These

laws relate to manufacture, supply, possession, transport, storage and use of fire-works.

Noise abatement measures adopted in some countries are:

- a) Germany, the use of fireworks is limited to one hour per year.
- b) The Netherlands, they can only be bought during a few allocated days just before the turn of the year, and can only be used one day around New Year's Eve.
- c) In England, fireworks are tradition-ally set off on Guy Fawkes Day, New Year's Eve, Diwali and Chinese New Year, and they can be purchased only a few days before these events.
- d) In France, fireworks are used around Bastille Day on 14 July.
- e) In Mediterranean countries, such as Spain or Malta, the use of consumer fireworks is extended, and they can be used throughout the year

### 11.3 Chemicals used in making fireworks

Pyrotechnic compositions are usually based on organic or inorganic chemical oxidizers and fuels to produce visual, thermal, audible or mechanical terminal effects, such as smoke, light, loud noise, motion, and color, the data below has been compiled from available literature on the subject.

**Table 11.1: Uses of main oxidizers / reducing agents in Consumer Fireworks**

<b>Oxidizers</b>	<b>Major uses</b>
Potassium perchlorate	Currently, the most used oxidizer in fireworks. It can be used in fuses and for producing effects such as noise, light, colored flames and smoke
Potassium nitrate	Oxidizer used as component of black powder. It is usually employed in safety fuses and lift charges
Potassium chlorate	It is usually used in dye smoke blends, matches, and toy caps. It should not appear with sulfur. It is banned in most countries
Strontium nitrate	It appears rarely as the only oxidizer. It is in red color flames
Barium nitrate	It can be used as oxidizer and green color agent in flames, smoke, and flash mixtures. It can produce white or silver effect with aluminium
Barium chlorate	It is used as oxidizer and color agent. In green smoke blends and green colored fire compositions. It must not be mixed with sulfur, realgar, red phosphorous or potassium chlorate

**Table 11.2: Uses of main oxidizers / reducing agents in Consumer Fireworks**

<b>As Fuels</b>	<b>Major uses</b>
Magnesium	It is used in flash powders and colored flames
Aluminium	It is the most widely used fuel. It produces brilliant flames and white sparks
Charcoal	Organic fuel used in black powder. It can produce orange sparks. Sometimes, it could be replaced by coal
Magnalium	Alloy of magnesium and aluminum (50/50; m/m) used to give yellowish white sparks. It is also in colored and crackling mixtures. It can be used in a black powder type composition or with potassium perchlorate
Titanium	It produces white-silvering or yellowish white brilliant sparks. Used in pyrotechnics fountains. It can also be mixed with a black powder type composition
Iron	Iron filings are used as fuel and to create yellow (gold) branching sparks, mainly in sparklers and fountains
Ferro-titanium	Alloy of iron and titanium used to create yellow white sparks in fountains and star compositions
Sulfur	Used in white and colored smoke composition, flash and sound blends. It is a component of black powder. It could also be used as oxidizer in some mixtures
Carbohydrates:	Sucrose, glucose, lactose, starch or dextrin They can be used in colored smoke blends as fuel. They also have binder properties
Accroides resin or acaroid gum	It is a resin obtained from plants. It can be used as fuel and binder. Commonly used in color fire and smoke compositions and flash powder
Polyvinyl chloride	It is used in colored flames. It is a compound of plastics
Red phosphorous	It is in toy caps, party poppers and trick-noise makers mixed with potassium chlorate. It is quite sensitive to friction and shock.
Shellac	It is used as fuel and binder in colored flames
Antimony trisulfide	It is sometimes used in glitter and fountain compositions to create bright light. It is a compound of sound mixtures.
Potassium benzoate	Whistling powder. It is used to produce loud sound
Sodium benzoate	It is most often used to make whistling noise

#### 11.4 Global approaches - analyses of consumer fireworks composition

There is a high forensic interest in the analysis of post-blast residues (PBRs) and pre-blast devices from incidents where consumer fireworks have been used. For analytical chemists, it is important to analyze consumer fireworks in order to know their composition for quality control. Only a few research works on the analysis of consumer fireworks by instrumental techniques have been published. Spectroscopy and scanning electron microscopy (SEM) have been the most explored techniques, (**Ref:** C. Martín-Alberca, C. García-Ruiz / Trends in Analytical Chemistry 56 (2014) 27–36; Analytical techniques for the analysis of consumer fireworks, Elsevier: [https://www.researchgate.net/publication/260030498\\_Analytical\\_techniques\\_for\\_the\\_analysis\\_of\\_consumer\\_fireworks](https://www.researchgate.net/publication/260030498_Analytical_techniques_for_the_analysis_of_consumer_fireworks) )

#### 11.5 International Organization for Standardization (ISO) - Fireworks Categories

The International Standard establishes a system for dividing fireworks into categories and types. ISO has divided fireworks into 4 categories – category 1, 2, 3 & 4 based on their hazardous nature and the noise they produce.

Fireworks are subdivided into four categories as follows:

- a) category 1: fireworks which present a very low hazard and negligible noise level and which are intended for use in confined areas, including fireworks which are intended for use inside domestic buildings;
- b) category 2: fireworks which present a low hazard and low noise level and which are intended for outdoor use in confined areas;
- c) category 3: fireworks which present a medium hazard, which are intended for outdoor use in large open areas and whose noise level is not harmful to human health.
- d) category 4: fireworks which present a high hazard, whose handling and use require specialist knowledge

#### 11.6 Harmonization of Standards on Firecrackers - ISO and BIS

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees (TC). International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electro-technical Commission (IEC) on all matters of electro-technical standardization. **ISO/TC 264** is the international Technical Committee dealing with firecrackers. India is a “P member” in ISO/TC 264, which means that India is mandated to participate in the activity of this committee and to cast vote

on draft documents and put forward views in the interest of India. The corresponding national Technical Committee of ISO/TC 264 in India is **CHD 26**.

The scope of ISO/TC 264 is:

*“Standardization in the field of Fireworks, including quality control, definitions, terminology, classification, categorization, labelling, test methods and basic safety requirements”.*

No standards have been published under ISO/TC 264 yet as it is a relatively new committee established in 2011.

To sum up the above:

- a) **ISO/TC 264** is the international technical committee dealing with firecrackers. **India** is a “P member” in ISO/TC 264, which means that India is mandated to participate in the activity of this committee and to cast vote on draft documents and put forward views in the interest of India.
- b) The corresponding national technical committee of **ISO/TC 264** in India is **BIS / CHD 26**.

Once, ISO standards are published, Indian experts in CHD 26 will review the ISO standards and recommend them for adoption if found suitable in Indian context. Since, ISO has not published any standards yet, India has not undertaken the process of adoption. The following are the ISO standards under development and are expected to be published soon:

<b>ISO/PRF 25947-1</b>	<b>Fireworks -- Categories 1, 2 and 3 -- Part 1: Terminology</b>
<b>ISO/PRF 25947-2</b>	Fireworks -- Categories 1, 2 and 3 -- Part 2: Categories and types
<b>ISO/PRF 25947-4</b>	Fireworks -- Categories 1, 2 and 3 -- Part 4: Test methods
<b>ISO/PRF 25947-3</b>	Fireworks -- Categories 1, 2 and 3 -- Part 3: Minimum labelling requirements
<b>ISO/PRF 26261-2</b>	Fireworks -- Category 4 -- Part 2: Requirements
<b>ISO/PRF 26261-1</b>	Fireworks -- Category 4 -- Part 1: Terminology
<b>ISO/PRF 26261-4</b>	Fireworks -- Category 4 -- Part 4: Minimum labelling requirements and instructions for use
<b>ISO/PRF 26261-3</b>	Fireworks -- Category 4 -- Part 3: Test methods
<b>ISO/PRF 25947-5</b>	Fireworks -- Categories 1, 2 and 3 -- Part 5: Requirements for construction and performance
<b>ISO/AWI 21583</b>	Firework displays -- General guidance
<b>ISO/DTR 21865</b>	Third party testing -- Voluntary scheme

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## Pollution abatement w.r.t. firecrackers: Challenges & Way forward

### 12.1 Environmental challenges in bursting firecrackers

PESO is authorised to issue licences for sale firecrackers. Hon'ble Supreme Court in November 2016 banned sale of firecrackers in Delhi NCT and NCR.

Major type of firecrackers:

- i. Sound emitting firecrackers and
- ii. Colour / light emitting firecrackers.

The common violations regarding firecrackers are:

- a) Non-compliance of noise pollution norms
- b) non-disclosure of chemical composition of manufacture on carton / packing box of firecrackers
- e) illegal manufacture & sale of firecrackers

### 12.2 Pollution abatement w.r.t. firecrackers: Challenges

Some major environmental challenges regarding regulating noise and chemical composition in bursting firecrackers are listed below:

1. **Firecracker bursting generate annoying noise levels:** Firecrackers are burst not only during festivals (Dussehra, Diwali etc.) but also during other occasions like marriages and local community functions. The duration of high decibel level firecrackers is very short, less than 10 seconds, the sound can be dangerous to the hearing power of an average healthy normal person. As high decibel levels crackers are harmful they should be avoided as it disturbs sleep and affect senior citizens and cardiac patients in particular. The noise levels can cause hearing loss depending on duration of exposure and distance from activity. It is a challenge to encourage citizens from buying 'noise' free fireworks despite there is no lack of knowledge in public domain on the hazards of being exposed to 'high decibels' noise.

The names of some 'noisy' firecrackers self suggest their purpose - "Atom Bomb (timing)" "Magic Fountain Bomb", "Rajan's Classic Dhamka" and "Hydrogen Bomb" !

2. **Non-compliance of noise standards of firecrackers** : As the sources of firecrackers (indigenous / smuggled) are uncertain monitoring hence compliance is a major constraint despite having noise level standards prescribed for firecrackers at manufacturing stage and the procedure for testing firecracker noise.
3. **Non-compliance of chemical composition of firecrackers** : PESO has stipulated chemical formulae for FOUR commonly used sound producing fireworks viz (a) Atom Bomb, (b) Chinese Crackers (this is a brand name and not imported product) (c) Maroons & (d) Garland Crackers. The chemistry of fireworks is based on combustive features of the ingredients which cause noise and lighting effects. Lack of requisite analytical facilities is a major challenge – besides the sources of firecrackers procurement (indigenous / smuggled) are uncertain.
4. **Chemical composition of firecrackers impacts health:** As bursting of firecrackers is a discrete impulsive event no survey has been done on this matter though it is widely known that firecrackers generate undesirable noise, emissions and there is a need to observe safety when bursting firecrackers.
5. **Fireworks is hazardous activity:**  
Two important references highlighted to emphasize on the activity are given below:  
Under the Explosives Rules, 2008:
  - a) Under Chapter-II Classification, Categorisation and Authorisation section 5. States ‘*Safety distance categories of explosives.—(1) Explosives are divided into four categories according to the risks which they present ‘ risks include ‘FIRE’*
  - b) Chapter III General provisions section 7. States Control over manufacture, import, export, transport, possession for sale or use of explosives.—*No person shall manufacture, import, export, transport, possess for sale or use an explosive except as authorised or licensed under these rules – as FIRE is a major risk*
  - c) Rule 113. “Documents for approval and grant of licence - Safety includes *safety from fire hazards*

In the report ‘Commentary on National Building Code (Part 4)’ – Fire and Life Safety: Final Report: C - Fire Codes IITK-GSDMA Project on Building Codes (CED-22 Fire Fighting Sectional Committee Bureau of Indian Standards).

6. **Non-compliance bursting of firecrackers due non-compatible landuse**

Though there is a restriction on complete ban on bursting firecrackers in 'silence zone' at night non-compliance is observed due to non-compatible landuse arising from rapid urbanisation in cities

Similarly though noise norms for area zones (residential & commercial) have been defined however the major constraint w.r.t. compliance are the activities arising from rapid urbanisation in the existing land-use in urban areas.

7. **Careless bursting firecrackers cause accidents:** Bursting firecrackers causing accidental burns and severe injuries of varying degrees. Accidents from firecrackers are mainly caused by any combination of the following :
  - i. Accidents at firecracker manufacturing unit
  - ii. In transit / at storage site
  - iii. During fireworks display
8. **Printed details on each box of firecracker:** Every manufacturer of firecrackers are required provide details of the chemical contents on the label of each box – however as the sources of manufacture are uncertain it is a challenge to differentiate between authorised / unauthorised makers at city outlets.
9. **Unauthorised manufacture of firecrackers:** This activity is done in several households across the country, hence a major challenge is how to ensure the composition of the firecrackers are as per norms, valid authorisations (fake branding of firecrackers) and covert mode of transportation.
10. **'FAKE imported' Firecrackers in the market:** Types and labels of firecrackers (patakas): Each year it has been observed that newer and newer firecrackers and labels are launched. It cannot be ruled out that there is a parallel business of 'fake' crackers too bearing popular firecrackers brand names and are being sold in several cities.
11. **'Imported firecrackers':** In year 2016 six cargo containers of Chinese firecrackers were seized in Delhi, the ministry of commerce and industry asked Directorate of Revenue Intelligence (DRI), Customs and state authorities to step up vigil against the banned crackers which suspected to be entering the Indian market through the ports under labels as toys, electronic goods or medical equipment far ahead of the festive season - Diwali. Delhi government formed 11 teams to crackdown on illegally imported crackers in year 2016. The firecracker made using potassium nitrate or sodium nitrate is several times costlier and 'less effective' than those made using potassium chlorate, hence crackers are being smuggled into the country. These firecrackers contain a banned explosive chemical -



potassium chlorate. There was presence of potassium chlorate in high levels at the accident site in Puttingal, Kerala where more than 100 people were killed and many were left injured in April 2016.

12. **Unauthorised public display of fireworks:** Severe tragedies have happened due to unauthorised (no license taken) display of fireworks. In year 2016 a major accident occurred due to unauthorized display of fireworks at the 500-year-old Devi Temple at Puttingal of Paravur municipality in Kollam, Kerala, claiming many lives and several were injured.
13. **Enforcement:** is a major challenge due to both – inadequate analytical / laboratory facilities & lack of adequate skilled manpower

### **12.3 Pollution abatement w.r.t. firecrackers: Way forward**

1. **"Be Safe Not Sorry":** It is reported that in United Kingdom, in Nottingham the "Be Safe Not Sorry" campaign was launched after region was inundated with letters from readers to newspaper saying that they were fed up with the noise nuisance and the distress that fireworks cause. Cities in our country can launch similar initiatives
2. **Public display of fireworks:** Fireworks display or 'pyrotechnics' is for demonstration of spectacular display of LIGHT. As the duration of such events are long (more than an hour) there will be provisions to store / stock for the occasion. The organisers need to take a necessary permission for storage of such fireworks as it can be 'explosive' depending on the type & quantity of stock quantity. Some abatement measures suggested are:
  - a. The display should be in open grounds, the public should be cordoned off at a safe distance from place of bursting crackers.
  - b. As the volume of firecrackers to be used is significant, such events should be banned in residential areas.
  - c. A license for a fireworks factory comes through only after clearances from the local police, pollution, health and other departments, lack of these documents should invite immediate penalty.

### **12.4 Some Do's & Don'ts – household / community level**

- i. The three general methods of minimizing the noise problems scientifically are :
  - To control the sound source
  - To modify the acoustic path from source to the listener
  - To protect the ears of the listeners (recipient)

- Celebrate festivals or usher in special events with LIGHT and not noise. Use noise – free fire crackers.
- ii. Bursting of crackers (particularly noisy ones) should be restricted and done before 10 pm.
  - iii. With crackers being burst at clustered spaces in the city during festivals, people are directly exposed to not only to noise but smoke too. Mass awareness plays a major role is disseminating messages on safety, environment and goodwill of the occasion through media (print, radio and TV). Citizens to voluntarily initiate in disseminating information- in the din of the excitation it generally forgotten the festivals are to be celebrated with LIGHT and not NOISE with safety as an important area.
  - iv. Mass awareness informing public on the do's & don'ts' should be encouraged thro print media, radio and internet.
  - v. The material of clothes worn should not be synthetic, cotton is preferable
  - vi. Always keep water and sand as protection measure in the vicinity of bursting fireworks.
  - vii. Children should be closely monitored.
  - viii. Burst firecrackers in open space so that sound from 'noisy' crackers do not re-bound
  - ix. Remember your responsibility towards senior citizens and cardiac patients when bursting banned (noisy) crackers
  - x. Sensitise school children: Encourage children to pledge to not burst noise emitting crackers.
  - xi. No cracker zone: As a community initiative , placards / boards / hoardings can be put up indicating 'NOISE FREE Firecracker Zone' during festivals as a part of public awareness.

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