



The Institute of Acoustics

Response to the Consultation Fireworks and Pyrotechnics in the UK

Introduction

The Institute of Acoustics (IOA) is the UK's professional body for those working in acoustics, sound, noise and vibration. The IOA has some 3000 members from diverse backgrounds, with engineers, scientists, educators, lawyers, occupational hygienists, architects and environmental health practitioners among their number. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, underwater acoustics, together with a variety of environmental aspects.

This consultation response was prepared by a group of members of the IOA, who have relevant experience in the impacts and effects of noise from fireworks on people and animals.

This response has been approved by the Executive Committee of the IOA on behalf of the Institute's Governing Council.

The IOA offers comment on questions where the subject matter falls within the IOA's area of expertise.

Consultation questions:

Question 1: Are there any other particular F2 and F3 fireworks products that you think the general public should not be allowed to buy? Please state which products and give your reasons.

Fireworks designed to be used in a mobile manner (e.g. not those designed for static displays) have potential to cause a wider spread of noise impact. Noise enforcement controls are anticipated to be easier to implement for static displays.

Question 2: If more products are added to the regulation 33 banned list, what consequences might there be for consumers, industry, enforcement authorities, professional users, and others? Please give your reasons.

Fireworks designed to be used in a mobile manner (e.g. not those designed for static displays) have potential to cause a wider spread of noise impact. Noise enforcement controls are anticipated to be easier to implement for static displays. Adding more products to the banned list could potentially reduce anti social use of fireworks and therefore reduce noise impact.

We are not aware of any research defining the relationship of firework noise level vs. enjoyment/satisfaction. However, it is recognised that if the sound level from any form of entertainment is too quiet, there is reduced audience satisfaction. Unless advertised as such, a silent firework display will not be enjoyed.



Question 3: Do you agree that regulation 33(1)(g) should be amended to make explicit that a firework comprising more than one shot tube is banned from sale to the general public?

- **Agree**
- **Disagree**
- **Neither agree nor disagree**

Please give your reasons.

No comment

Question 4: Do you agree that the age limit for purchasing Christmas crackers should be removed?

- **Agree**
- **Disagree**
- **Neither agree nor disagree**

Please give your reasons.

No comment

Question 5: Are there any other specific F1 and P1 pyrotechnics that should have their regulatory requirements increased or decreased? Please state which products, what regulatory requirements you think they should have and give your reasons.

It does not seem appropriate to have the same noise limit for F1 and P1 pyrotechnics, that are commonly used indoors, as for those used outdoors, given that, indoors, the resulting sound level from the same pyrotechnic could be higher as a result of reflections from the internal structure.

Section 2: Reducing noise impacts

Question 6: Do you agree the decibel level of fireworks consumers use should be lowered? Choose one of the following options:

- No, the maximum noise limit for fireworks should remain at 120 dB (A,imp)
- Yes, to 110 dB (A,imp) (reducing perceived loudness by approximately half)
- Yes, to 100 dB (A,imp) (reducing perceived loudness by approximately three-quarters)
- Yes, to 90 dB (A,imp) (reducing perceived loudness by approximately seven-eighths)
- Don't know

Don't know.



In order to answer this question, we need know why a limit is required and to understand why the figure of 120 dB(A,imp) (120 dB, $L_{A\max}$)¹ at the safety distance has been used in the past and, just as importantly, why the parameter $L_{A\max}$ was chosen.

The main direction of the noise considerations in the consultation document is towards the mitigation of fear, startle and annoyance in humans and animals. That also seemed to be the case when the Fireworks Act 2003 was debated in Parliament. At the second reading all the adverse points mentioned by MPs were about the effect on non-participants [1] and in that debate the figure of 120 dB was mentioned several times (though without any parameter) and it was suggested that it came from the EU European Standards Committee which subsequently produced a standard using a value of 120 dB, $L_{A\max}$ in 2007 [2]. This level was later adapted in the Pyrotechnic Articles (Safety) Regulations 2015 as 120 dB(A,imp), which is equivalent to 120 dB, $L_{A\max}$. Unfortunately, we can trace no evidence as to why that value was considered appropriate for either UK regulations or for the EU standard.

A short time before the Fireworks Act 2003, the World Health Organisation (WHO) [3] published guidance which stated that fireworks noise should not exceed 120 dB, $L_{Z\text{peak}}$ (unweighted) at 10 cm from the ear in order to protect children's hearing. However, and this is most important, the parameter used by WHO was $L_{Z\text{peak}}$, not $L_{A\max}$. We can also trace no evidence to support this level of 120 dB, $L_{Z\text{peak}}$ as being appropriate to protect children's hearing, though it is known now that levels of more than 135 to 140 dB, $L_{C\text{peak}}$ measured at the ear may damage adult hearing.

The matter of the different parameters is very important. The $L_{A\max}$ parameter does not capture the instantaneous sound pressure peak as is the case for either the $L_{Z\text{peak}}$ or $L_{C\text{peak}}$ indicators. Because of this ability to capture the instantaneous sound pressure, peak sound pressure levels will always be higher than impulse-weighted levels. However, this difference is not straightforward to estimate and is highly dependent on the nature of the sound, particularly its impulsivity and frequency content. A paper from India in 1999 [4] suggests that for aerial shots the $L_{C\text{peak}}$ is about 20 dB more than $L_{A\max}$ and for ground shots it is 25 dB more. The $L_{Z\text{peak}}$ and $L_{C\text{peak}}$ can be considered similar for this purpose. The difference between the different parameters could be more reliably estimated for different types of fireworks based on a measurement campaign similar to the one described in the OPSS "Noise testing of fireworks" [5] but including measurements of both $L_{A\max}$ and $L_{Z\text{peak}}$. Unfortunately, this OPSS document does not provide any measurements of $L_{Z\text{peak}}$ or $L_{C\text{peak}}$.

It is also worth noting that any sound pressure level quoted must have a measurement location specified, such as distance from the source, in order to be meaningful. Pyrotechnic Articles (Safety) Regulations 2015 specify this to be at least 1 m for category F1 fireworks, at least 8 m for category F2 fireworks, and at least 15 m for category F3 fireworks².

As far as reducing fear, startle and annoyance in humans and animals is concerned there does not seem to be any evidence to help decide whether the limit should be reduced or not. We think it is likely that a reduction of 10 dB or more would reduce the adverse impact on people and animals but could also reduce the enjoyment of spectators of the event. However, we do not have the evidence to quantify either of these effects.

As regards the possibility of hearing damage, based on the paper cited above, 120 dB(A,imp) (120 dB, $L_{A\max}$) might be around 140 dB, $L_{C\text{peak}}$ for aerial shots and 145 dB, $L_{C\text{peak}}$ for ground

¹ This is the correct way of expressing this indicator

² We note that, in the Pyrotechnic Articles (Safety) Regulations 2015, the safety distance must be "at least" 1, 8 or 15m according to the category and that the specified limit is 120 dB $L_{A\max}$ "at the safety distance". Consequently, if a manufacturer decides to have a larger safety distance, they can have a higher sound pressure level.



shots. This, of course, is at the safety distance of 1 m, 8 m or 15 m. At double the safety distance ground shots would be about 139 dB, L_{Cpeak} and aerial shots might be about 137 dB, L_{Cpeak} , the lesser reduction because the noise source is in the air and the distance of the noise source has not doubled. So, 120 dB(A,imp) (120 dB, L_{Amax}) appears to be marginal to protect adult organisers and others close to the event, but if children have hearing more sensitive to impulse noise that level would not protect them.

The point made in the consultation document at section 2 is that “*gaming of the fireworks noise testing system [took place] due to the challenges of effectively defining a 90 decibel limit in legislation.*” Defining a limit in legislation is not a problem (the current UK fireworks regulations do just that). The problem with the NZ COP is that the parameter to be used was not specified so the limit is simply not defined.

The final question is whether we should still use L_{Amax} to measure the sound level of fireworks, or should we move to a different metric, like L_{Zpeak} or L_{Cpeak} . The impulse time weighting was introduced in the late 60s to offer a more rapid time weighting than the Fast weighting, at a time when recording true peak values on analogue sound level meters was not feasible. However, it was removed in the 2003 version of the standard with the following comment: “*Various investigations have concluded that time-weighting I is not suitable for rating impulsive sounds with respect to their loudness. Time-weighting I is also not suitable for assessing the risk of hearing impairment, not for determining the ‘impulsiveness’ of a sound. Because of the possibility of obtaining misleading results, time-weighting I is not recommended for the purposes described above*” [6]. The L_{Cpeak} parameter would be a good candidate for replacing L_{Amax} as the C frequency weighting was designed to approximate human hearing at high sound pressure levels. The parameter is already used in The Control of Noise at Work Regulations [7].

In summary, there is not enough evidence to say, with confidence, what exact A-weighted, impulse-weighted (L_{Amax}) sound pressure level would be required to improve significantly the wellbeing of humans or animals. However, there is reason to believe that the 120 dB(A,imp) (120 dB, L_{Amax}) level measured at the safety distance should be reduced to protect the hearing of children.

References

[1] UK Parliament, House of Commons, “Fireworks Bill,” *Hansard*, vol. 400, cols. 475-527, Feb. 28, 2003. [Online]. Available: <https://api.parliament.uk/historic-hansard/commons/2003/feb/28/fireworks-bill> [Accessed: 28 September 2026]

[2] European Parliament and Council, “Directive 2007/23/EC of the European Parliament and of the Council of 23 May 2007 on the placing on the market of pyrotechnic articles,” *Official Journal of the European Union*, vol. OJ L 154, pp. 1–21, Jun. 2007. [Online]. Available: <https://eur-lex.europa.eu/eli/dir/2007/23/oj> [Accessed: 23 September 2026]

[3] World Health Organization, “Guidelines for community noise”, 1999. Available: <https://www.who.int/publications/i/item/a6867> 2 [Accessed: 07 August 2026]

[4] O. Sharma, V. Mohanan, and M. Singh, “Characterisation of sound pressure levels produced by crackers”, *Applied Acoustics*, vol. 58, no. 4, pp. 443–449, 1999, doi: 10.1016/S0003-682X(99)00010-9.

[5] Office for Product Safety and Standards, “Noise testing of fireworks,” 2023. Available: <https://www.gov.uk/government/publications/noise-testing-of-fireworks> [Accessed 07 August 2026]



[6] *Electroacoustics. Sound level meters. Specifications*, BS EN 61672-1:2003, British Standards Institution, London, 2003

[7] *The Control of Noise at Work Regulations 2005*, SI 2005/1643. [Online]. Available: <https://www.legislation.gov.uk/ukxi/2005/1643/contents> [Accessed: 28 September 2026]

Question. 7. What might be the positive impacts of reducing the maximum decibel level of fireworks available to the general public? Please explain your answer, providing evidence where possible.

Although reducing the maximum sound level of fireworks to be in line with the WHO recommendations would be a good step towards preventing hearing loss from noise exposure, it is not known whether this level would be enough to decrease other negative effects of fireworks noise on humans and animals, such as stress and fear, beyond the obvious benefit of reducing the spread of such impact by reducing the noise level at source.

The negative effects of fireworks noise on animals in particular are well documented. This includes pet dogs (e.g. [1], [2], [3]), horses, who risk injury to themselves and people due to fear reactions [4], [5], [6] as well as wildlife. Wild birds in particular have been reported to take off en masse [7], [8], [9], change their roosting habits after experiencing fireworks in a particular location [8], [10] and even abandon their nests around the time of a fireworks display [11].

References

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- [2] L. M. Storengen and F. Lingaas, 'Noise sensitivity in 17 dog breeds: Prevalence, breed risk and correlation with fear in other situations', *Applied Animal Behaviour Science*, vol. 171, pp. 152–160, Oct. 2015, doi: 10.1016/j.applanim.2015.08.020.
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- [5] Redwings Horse Sanctuary, 'Fireworks and Horses. A horse owner survey', 2025.
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[8] A. Kölzsch et al., 'Wild goose chase: Geese flee high and far, and with aftereffects from New Year's fireworks', *Conservation Letters.*, vol. 16, no. 1, p. e12927, Jan. 2023, doi: 10.1111/conl.12927.

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[10] K. Karolewski, M. Bocheński, O. Ciebia, D. Markulak, and L. Jerzak, 'New Year's Eve Fireworks Impact On The Number Of Magpies On The Roosting Place', *International studies on sparrows*, vol. 38, no. 1, pp. 27–29, 2014, doi: 10.1515/isspar-2015-0029.

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Question 8: What might be the negative impacts of reducing the maximum decibel level of fireworks available to the general public? Please explain your answer, providing evidence where possible.

We are not aware of any research defining the relationship of firework noise level vs. enjoyment/satisfaction. However, it is recognised that if the sound level from any form of entertainment is too quiet, there is reduced audience satisfaction. Unless advertised as such, a silent firework display will not be enjoyed.

IOA Comments

There is not enough evidence to confidently say what exact A-weighted, impulse-weighted ($L_{A\max}$) sound pressure level would be required to improve significantly the wellbeing of humans or animals. However, there is reason to believe that the 120 dB(A,imp) (120 dB, $L_{A\max}$) level measured at the safety distance should be reduced.

The WHO recommends that "to avoid hearing loss from impulse noise exposure, peak sound pressures should never exceed 140 dB for adults, and 120 dB for children" measured 10 cm from the ear [1]. However, it must be pointed out that peak sound pressure level – as specified in the WHO report – will always be higher than impulse-weighted level – the basis of current UK regulation. Unweighted sound level (WHO) is also likely to be higher than A-weighted level (UK regulations) for fireworks noise. Therefore, a child standing at the safety distance from a firework with 120 dB(A,imp) (120 dB, $L_{A\max}$) will most likely experience sound pressure levels which exceed WHO recommendations.

If the difference between $L_{A\max}$ and $L_{Z\text{peak}}$ for the same sound was known, it could be used to bring the UK fireworks regulation in line with the WHO recommendation. However, it is not straightforward to estimate this difference, which is highly dependent on the nature of the sound source, particularly its inherent impulsivity and frequency content. It could be estimated for different types of fireworks based on a measurement campaign similar to the one described in the OPSS "Noise testing of fireworks" [2] but including measurements of both $L_{A\max}$ and $L_{Z\text{peak}}$.



Although reducing the maximum sound level of fireworks to be in line with the WHO recommendations would be a good step towards preventing hearing loss from noise exposure, it is not known whether this level would be enough to decrease other negative effects of fireworks noise on humans and animals, such as stress and fear.

In addition, we would add that the impact of firework noise on humans and animals, like stress and fear, are dependent on the context and behaviour of those igniting them. For example, anticipated celebrations like Nov 5th, Halloween, Diwali, New Year might have less impact on people than fireworks used at unexpected times. Whilst pet and livestock owners can take precautionary measures for those events, wildlife will not be prepared for these events, and unanticipated firework noise can be disruptive to all.

References

[1] World Health Organization, "Guidelines for community noise", 1999. Available: <https://www.who.int/publications/i/item/a68672> [Accessed 07 August 2026]

[2] Office for Product Safety and Standards, "Noise testing of fireworks," 2023. Available: <https://www.gov.uk/government/publications/noise-testing-of-fireworks> [Accessed 07 August 2026]

If officials would like to explore further any of the points raised, relevant members of the IOA would be delighted to meet with them.

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