# IMPULSE MEASUREMENT CONSIDERATIONS IN SETTING OCCUPATIONAL NOISE CRITERIA

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The most common occupational noise limits are 85 dBA Leq and 140 dBZpeak for 100 impulses. Simple arithmetic shows that 100 high frequency pulses at 140 dBZ for 0.9 msec each will give 85 dBA (assuming the A-weighting has little effect due to the frequencies involved), i.e. in practical terms the Leq limit will usually be exceeded before the impulse limit. To check this in practice over 400 measurements were reviewed from a smelting and casting facility and from an ore milling operation. These measurements included impulse noise from jack hammers, pneumatic motors and exhausts, heavy scrap dropping into bins, etc. In no case was 140 dB exceeded, although 85 dBA was exceeded in many cases. More important, in every case the 85 dBA Leq limit would be exceeded well before the 140 dBZpeak limit. It is well known that noise dosimeters are unreliable in measuring impulse noise due to false impulses caused by rubbing the microphone and cable. As a result, routine assessment of impulse noise is much more difficult (expensive) than assessments using just Leq. It is concluded that in practice there is little advantage, and some decided disadvantages, to doing routine assessment (or regulation) of impulse noise exposure in industry.

## 1. INTRODUCTION

Almost every occupational criterion or regulation in the world controls two items: $L_{eq}$ and impulse noise, the latter usually measured as $L_{peak}$ with either a C or Z (linear) weighting. Now that many occupational noise assessments are done with noise dosimeters this tends to cause a concern. Modern high crest factor dosimeters, while able to measure impulse noise and also to correctly measure $L_{eq}$ of sound including impulses are often subject to false readings due to high impulses produced by the cable or microphone rubbing on clothing. This has been noted in explicit warnings in CSA Z107.56[1] and ISO 9612[2]. Impulse measurements using an attended impulse sound level meter are needed by both standards to confirm any impulse measurements. This extra measurement is time consuming and inefficient, regardless of whether impulses are found.

There is considerable question as to whether this extra complication actually helps establish whether workers are being over exposed to noise since it clearly takes very little impulse noise in an 8 hour shift before both the $L_{eq}$ limit and the $L_{peak}$ limit are both exceeded. If the $L_{eq}$ limit is exceeded anyway, then there is little point in knowing whether the $L_{peak}$ limit is exceeded as well, especially if it complicates the overall assessment.

Table 1 (Reference 3) summarises the noise regulations across Canada. Most regulations include, as limits for over exposure, both $L_{eq}$ > 85 dBA and $L_{peak}$ > 140 dB (for 100 impulses). Assuming that most impulses contain considerable high frequency sound one can expect the A weighted and linear sound levels to be of similar magnitude. It is then simple arithmetic to show that 100 impulses 0.9msec long will contain sufficient energy to reach 85 dBA $L_{eq}$ over an 8 hour shift. These are sufficiently short impulses to justify the assumption that they contain significant high frequencies to make A-weighted and linear measurements similar. Impulses containing more low frequencies will, of necessity, be longer in duration and thus again probably will cause the 85 dBA $L_{eq}$ limit to be exceeded. This argument indicates that in practice the 140 dB Peak limit rarely, if at all, is exceeded before the 85 dBA $L_{eq}$ limit has already been exceeded.

**Table 1 Noise Regulations in Canada (Ref. 3)**

| Jurisdiction (federal, provincial, territorial) | Continuous Noise | | Impulse / Impact Noise | |
|---|---|---|---|---|
| | Maximum Permitted Exposure Level for 8 Hours: dB(A) | Exchange Rate dB(A)+ | Maximum Peak Pressure Level dB(peak) | Maximum Number of Impacts |
| Canada (Federal) | 87 | 3 | - | - |
| British Columbia | 85 | 3 | 140 | - |
| Alberta | 85 | 3 | - | - |
| Saskatchewan | 85 | 3 | - | - |
| Manitoba | 85 | 3 | - | - |
| Ontario | 90 | 5 | - | - |
| Quebec | 90 | 5 | 140 | 100 |

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|---|---|---|---|---|
| New Brunswick | 85 | 5 | 140 | 100 |
| Nova Scotia | 85 | 3 | 140 | 100 |
| Prince Edward Island (references ACGIH TLVs) | 85 | 3 | - | - |
| Newfoundland | 85 | 3 | - | - |
| Northwest Territories | 85 | 5 | 140 | 100 |
| Nunavit | 85 | 5 | 140 | 100 |
| Yukon Territories | 85 | 3 | 140 | 90 |

## 2. Measurements

To check this argument in practice, over 400 measurements were examined from two large industrial plants: a smelting and casting facility and an ore milling operation. These included measurements of impulse noise from many different sources, including jack hammers, pneumatic motors, pneumatic exhausts and heavy scrap dropping into bins. Most measurements were taken at potential operator locations, or 1m from the equipment being measured.

For each measurement. Figure 1 compares the difference between $L_{eq}$ and $L_{peak}$ to the difference between the two limits:140 dB and 85 dB. It is calculated by subtracting each measurement from its appropriate limit and then taking the difference between the two results. A positive value indicates the $L_{eq}$ is closer to exceeding the 85 dBA limit than the $L_{peak}$ is to exceeding the 140 dB limit.

It is clear from the results that in none of these measurements will the $L_{peak}$ measurement have any effect on determining whether the criteria are exceeded. Indeed in most cases the $L_{eq}$ is 30 dB closer to its limit than $L_{peak}$. The two measurements with the lowest difference were a pneumatic tamping machine at 11.9 dB (probably with some rattling parts) and an empty steel scrap bin (at 16.8 dB) with a cubic foot of scrap being dropped into it from a height of over a metre.

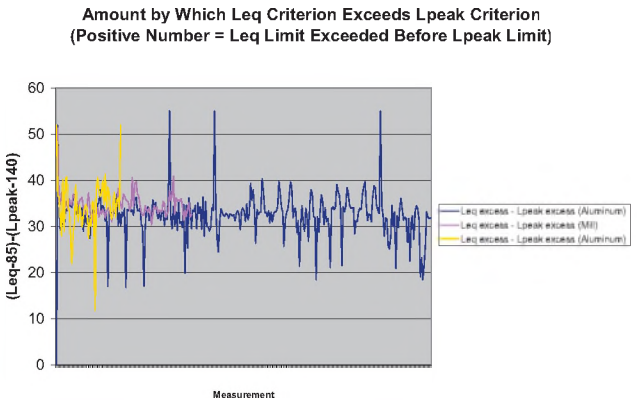


**Figure 1 Extent to which Leq is more important than Lpeak in determining excess over occupational limits**

## 3. Conclusions

It is clear both from time considerations and from the measurements examined that the $L_{peak}$ measurement used in most occupational criteria and regulations has little practical effect. In view of the difficulties this measurement poses to the use of noise dosimetry for assessment and its lack of usefulness, it is recommended that provinces and other regulators consider dropping the use of impulse criteria or limiting its use to very specific cases. In practice there appears to be little point in measuring $L_{peak}$ even when it is regulated. It should only be measured in exceptional cases since its measurement is unlikely to have any effect on the outcome of assessments in the vast majority of cases.

## REFERENCES


1. Canadian Standard Z107.56, Procedures for the Measurement of Occupational Noise Exposure, 2006
2. ISO/CD 9612, Acoustics -- Guidelines for the measurement and assessment of exposure to noise in a working environment, 2006
3. http://www.ccohs.ca/oshanswers/phys_agents/exposure_can.htmlNational Guidelines for Environmental Noise Control, ISBN: 0-662617014-8, 1989