Noise at Pop Concerts: Review of Guidance, and good measurement practice inside and outside the venue

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LDS LOCHARD

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Introduction

- Dan Saunders, AMIOA
- 3 years with B&K
- Previously at two local authorities
- PG Dip
- Currently studying for MSc Applied Acoustics

Introduction

1. Review of existing COP
2. Good practice in noise measurements
3. Emerging technologies and case study

The existing Code of Practice

- Code of Practice on Environmental Noise Control at Concerts
- Published by the Noise Council, 1995
- “A Working Party comprising specialists who are experienced in the particular problems that can arise with environmental noise control at concerts and similar music events.”
- Guidance – balanced view for acceptable noise guidelines

The procedure

- Planning for the event
  - Determine sound propagation between venue and receptors, and carry out background noise survey (competent person).
  - Check viability of event against guidelines
  - LA to make use of licensing conditions to implement procedures in COP
  - Appoint noise consultant
- Before the event
  - Install and align loudspeaker system, optimise orientation to minimise disturbance
  - Carry out a sound test to ascertain maximum level at monitoring position to enable guidelines to be met.
- During the event
  - Advertise and operate attended complaints line
  - Carry out noise monitoring inside and outside the venue

COP – cont'd.

- Some definitions
  - Music noise - The noise from the music and vocals during a concert or sound checks and not affected by other local noise sources
  - Music Noise Level (MNL) - The LAeq of the music noise measured at a particular location.
    - » 1 metre from the façade of any noise sensitive premises (for events held between the hours of 0900 and 2300)

TABLE 1

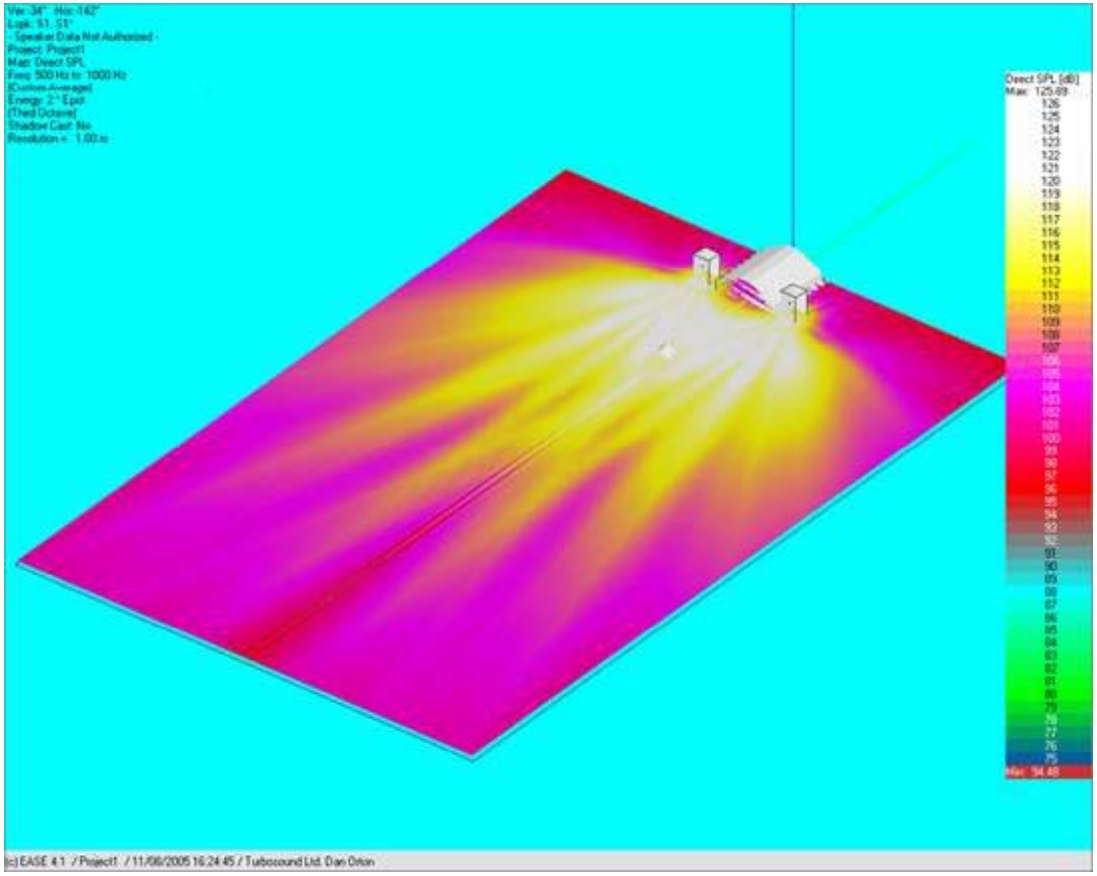
Concert days per calendar year, per venue	Venue Category	Guideline
1 to 3	Urban Stadia or Arenas	The MNL should not exceed 75dB(A) over a 15 minute period
1 to 3	Other Urban and Rural Venues	The MNL should not exceed 65dB(A) over a 15 minute period
4 to 12	All Venues	The MNL should not exceed the background noise level[1] by more than 15dB(A) over a 15 minute period

Recommended procedure

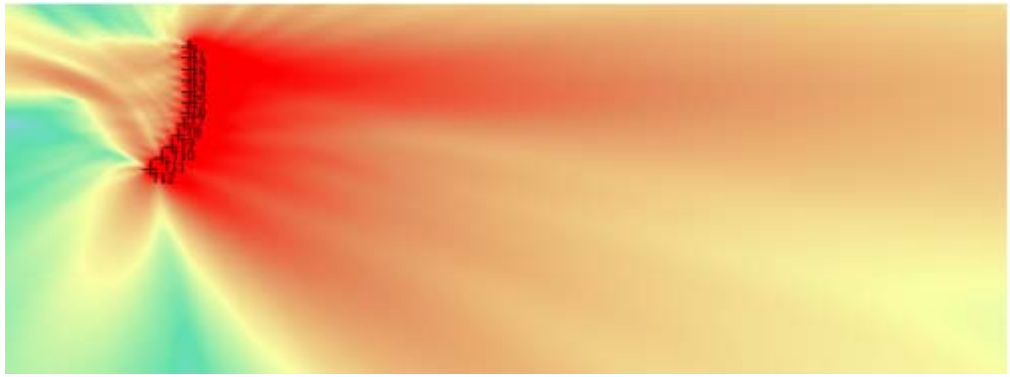
- Determine the sound propagation characteristics between the proposed venue and those living nearby who might be affected by noise, and carry out an appropriate background noise survey.

- Check the viability of the event against the guidelines
  - Levels below 95 dB(A) at mixer unlikely to provide satisfactory entertainment
  - Research shows that the music noise level in the audience by the mixer position at pop concerts is typically 100 dB(A)
    - » Remember this is an L_{Aeq}
    - » The Who – 126 dB at 32 m from speakers 1976
    - » Manowar achieved Lp of 139 dB during sound check 2008

Determining sound propogation



Determining sound propogation



- Or use a speadsheet / manual calculation
- 6 dB per doubling of distance for point source
- Correction for orientation - Could be 3dB between 45 and 60 degrees, 9dB at 90 degrees and 15dB at 180 degrees
  - This is frequency dependant in practice

Speaker configuration

Speaker configuration

Speaker configuration

- Delay towers to augment the main system

What is MNL?

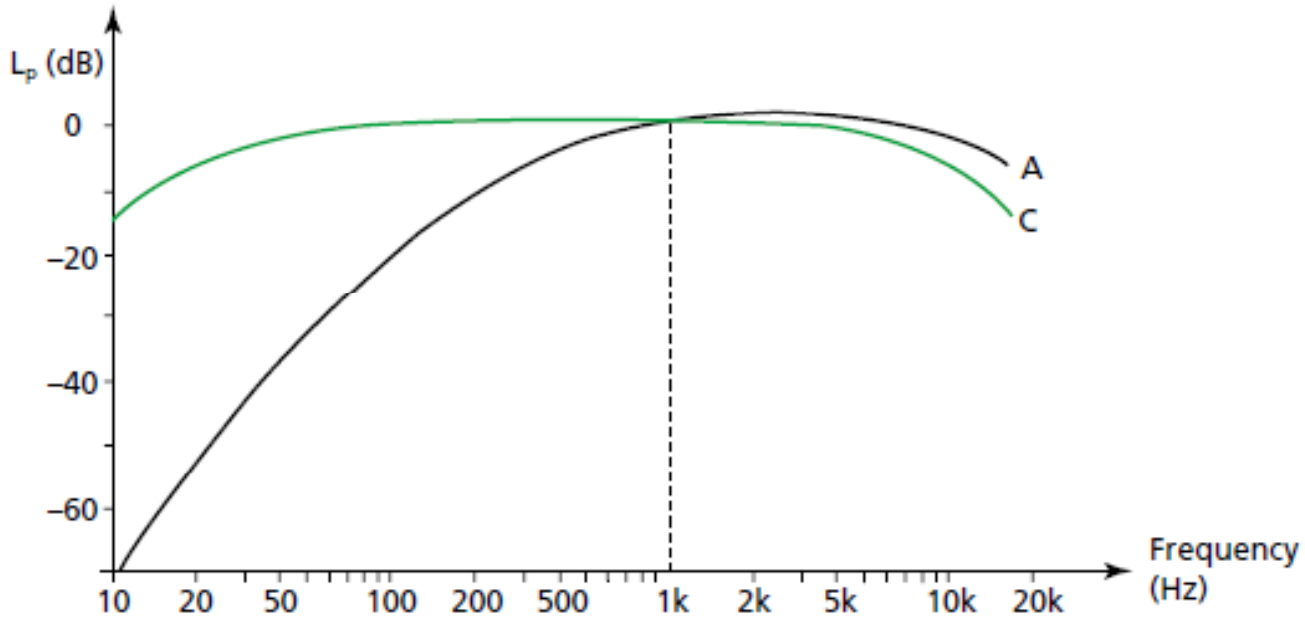
- "The **Music Noise Levels (MNL)** *(LAeq)* when assessed at the prediction stage or measured during sound checks or concerts should not exceed the guidelines shown in Table 1 at **1 metre from the façade of any noise sensitive premises** for events held between the hours of 0900 and 2300."

- Low frequency noise:

  - "Assessment of noise in terms of dB(A) is very convenient but it can underestimate the intrusiveness of low frequency noise."

  - (Music Noise Level (MNL) - The LAeq of the music noise measured at a particular location.)

A weighted sound



- With certain types of events, therefore, it maybe necessary to set an additional criterion in terms of low frequency noise, or apply additional control conditions.

A note on low frequency noise

- Note 1
  - It has been found that it is the frequency imbalance which causes disturbance. Consequently there is less of a problem from the low frequency content of the music noise near to an open air venue than further away.

- Note 2
  - Although no precise guidance is available the following may be found helpful (Ref 8):
  - A Level up to 70dB in either of the 63Hz or 125Hz octave frequency band is satisfactory: a level of 80dB or more in either of those octave frequency bands causes significant disturbance.
    - » Note 63 Hz octave differs from 63 Hz 1/3 octave (=50+63+80Hz 1/3rd octaves) i.e. 85dB

A note on low frequency noise

- Ref 8:

A STUDY OF LOW FREQUENCY SOUND FROM POP CONCERTS

J Griffiths (1), J Staunton (1), & S S Kamath (2)

(1) Travers Morgan Ltd
(2) London Borough of Brent

- "Comparisons have been made at distances in excess of 2km"

Sound pressure levels in excess of 80dB in the 63Hz or 125Hz octave bands recorded in excess of 2Km from the concert, are likely to give rise to complaints of low frequency noise. Levels below 70dB are likely to be acceptable.

Low frequency noise

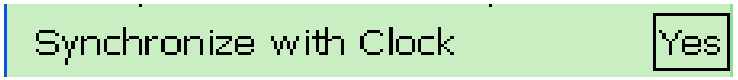
- Low frequency noise can be difficult to measure accurately near facades
- MNL = LAeq 1m from façade, i.e. not low frequencies
- Study of low frequency noise from concerts – free field measurements
- *Research by Quirt and Hall (et al) commented on in NNIS 2000.*

- The authors investigated traffic noise levels flush with façade, and 2m away
  - *3 dB difference reasonable between 200Hz – 2kHz,*
  - but gave misleading results below 200Hz

When is 15 minutes not 15 minutes?

- “The control limits set at the mixer position shall be adequate to ensure that Music Noise Level (MNL) shall not at any noise sensitive premises exceed dB(A) over a 15 minute period…”

- 4 ways of measuring 15 minutes:
  - Exact quarters, :00 to :15, :15 to :30, :30 to :45 and :45 to :00



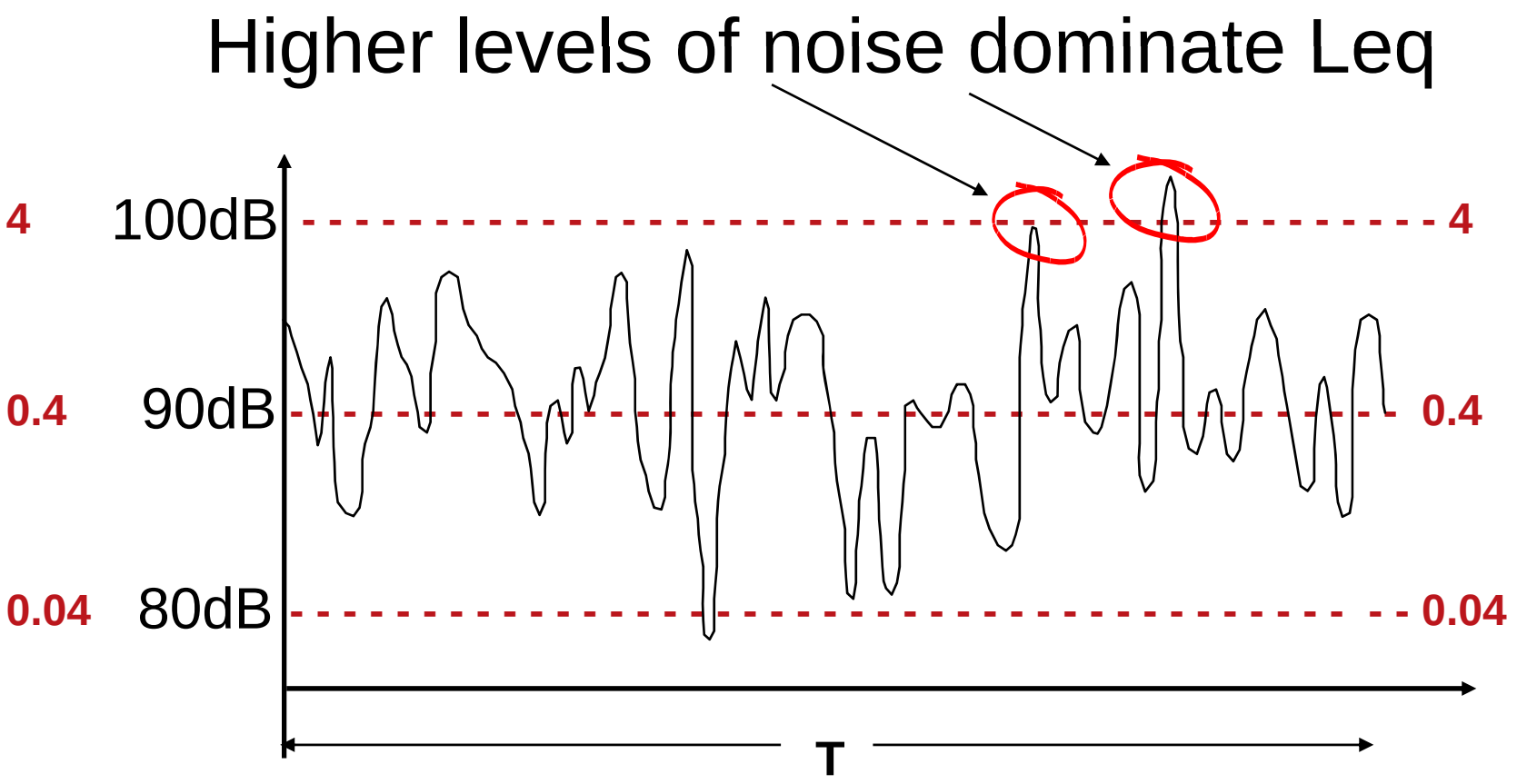
  - Start at any time, and measure for 15 minutes
  - Start at any time and measure for 15 minutes excluding pauses
    - » Could end up being a long measurement!
  - Use a rolling 15 minute Leq

- Difficult to control effectively unless exact quarters are being used

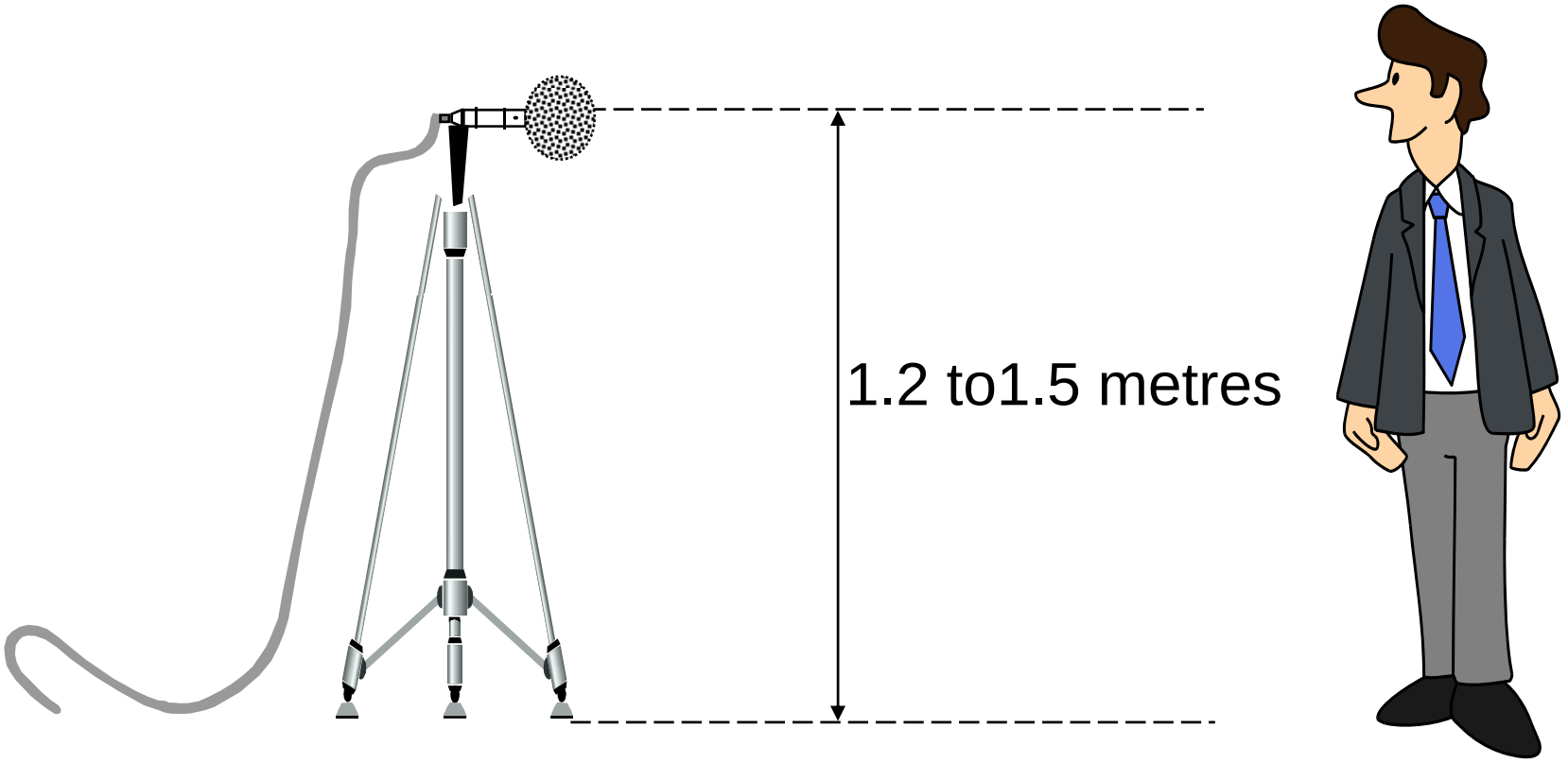
Extraneous noise (residual noise)

- When measuring LAeq in order to determine the music noise level, care must be taken to avoid local noise sources influencing the result.
- When the local noise is intermittent, a series of short term LAeq measurements should be made of the music noise while the local source is absent or has subsided to typically low or mean minimum values. An average of these short term readings will give an estimate of the music noise level.
- Measure the A-weighted sound pressure level, time weighting set to S (slow response) when the music is loudest and not influenced by local noise.
- If the local source is continuous, make a measurement of the LAeq of the local source when the music is not occurring, and make a correction to the measured LAeq when the music is occurring to obtain an estimate of the music noise level.

$L_{Aeq,T}$ calculation

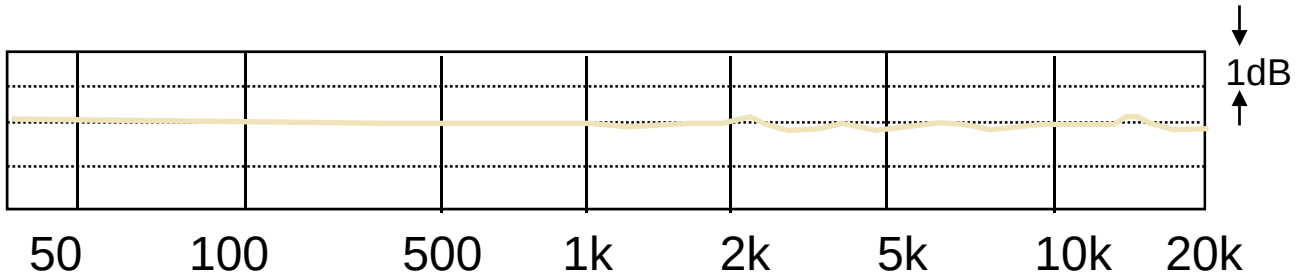


Microphone Positioning



Microphone Positioning

No influence from the observer



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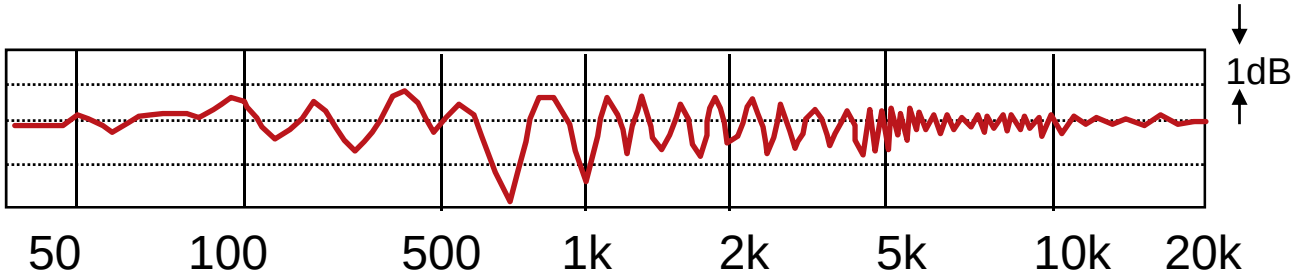
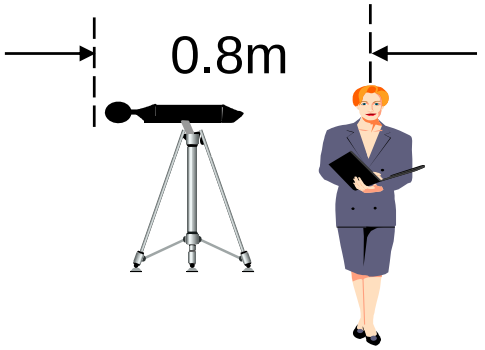
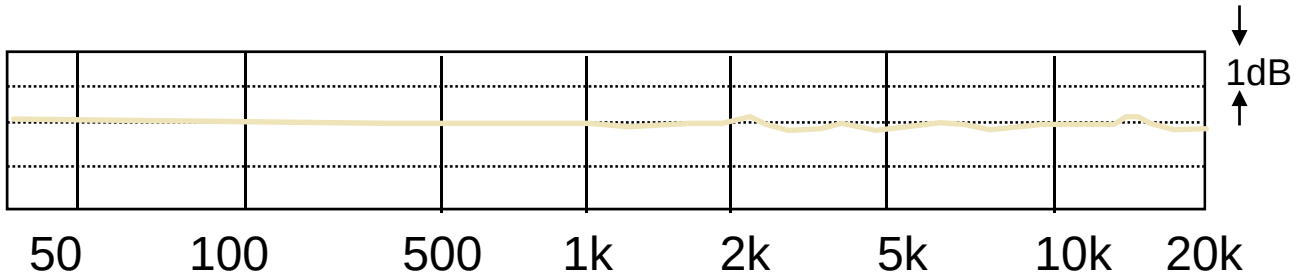


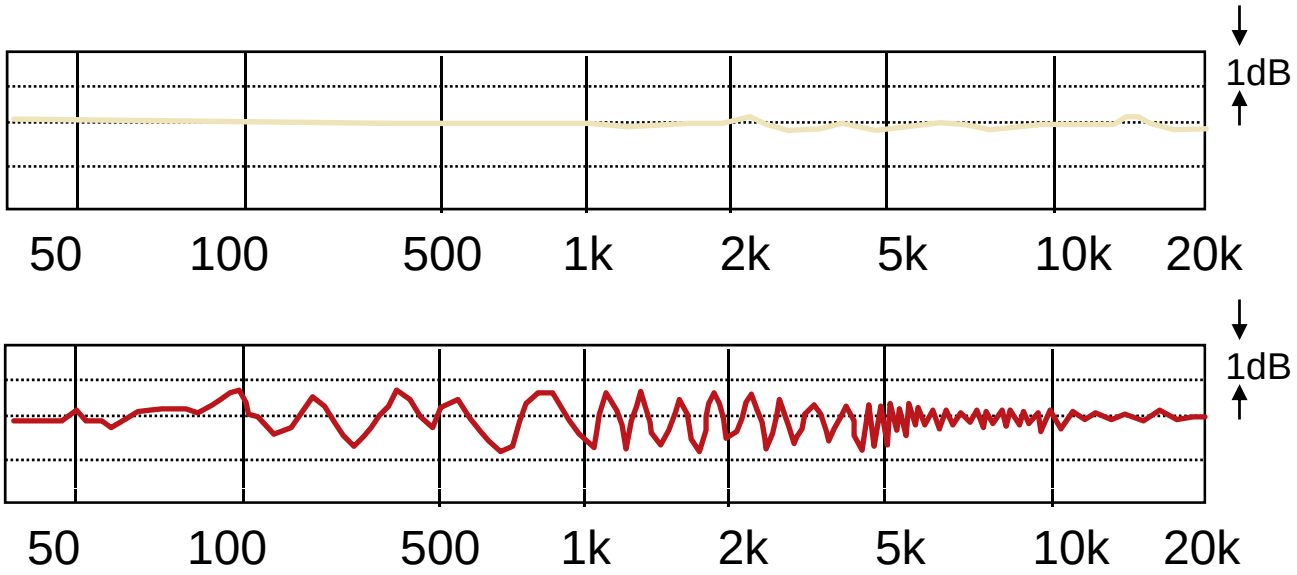


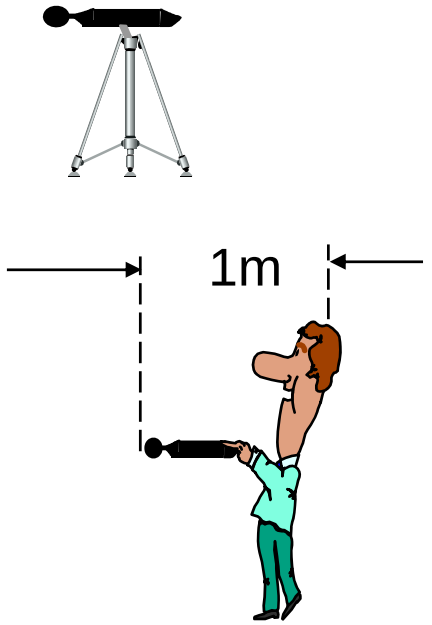


Observer in close proximity

Microphone Positioning

Hand held measurement

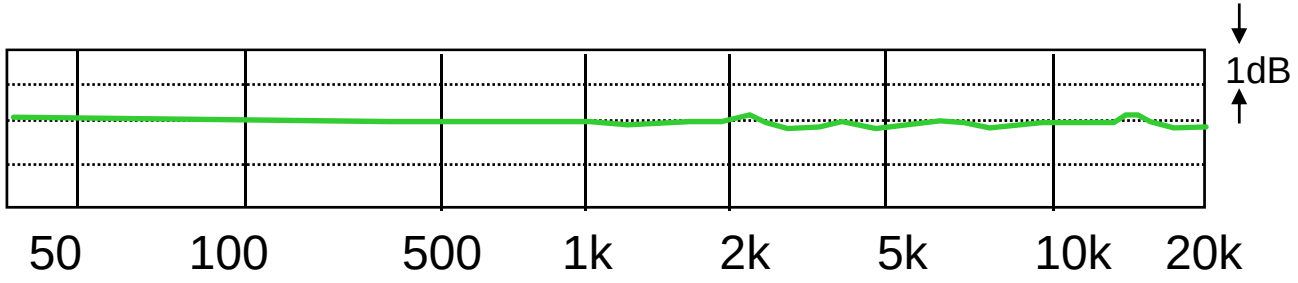




Microphone Positioning – use of tripods

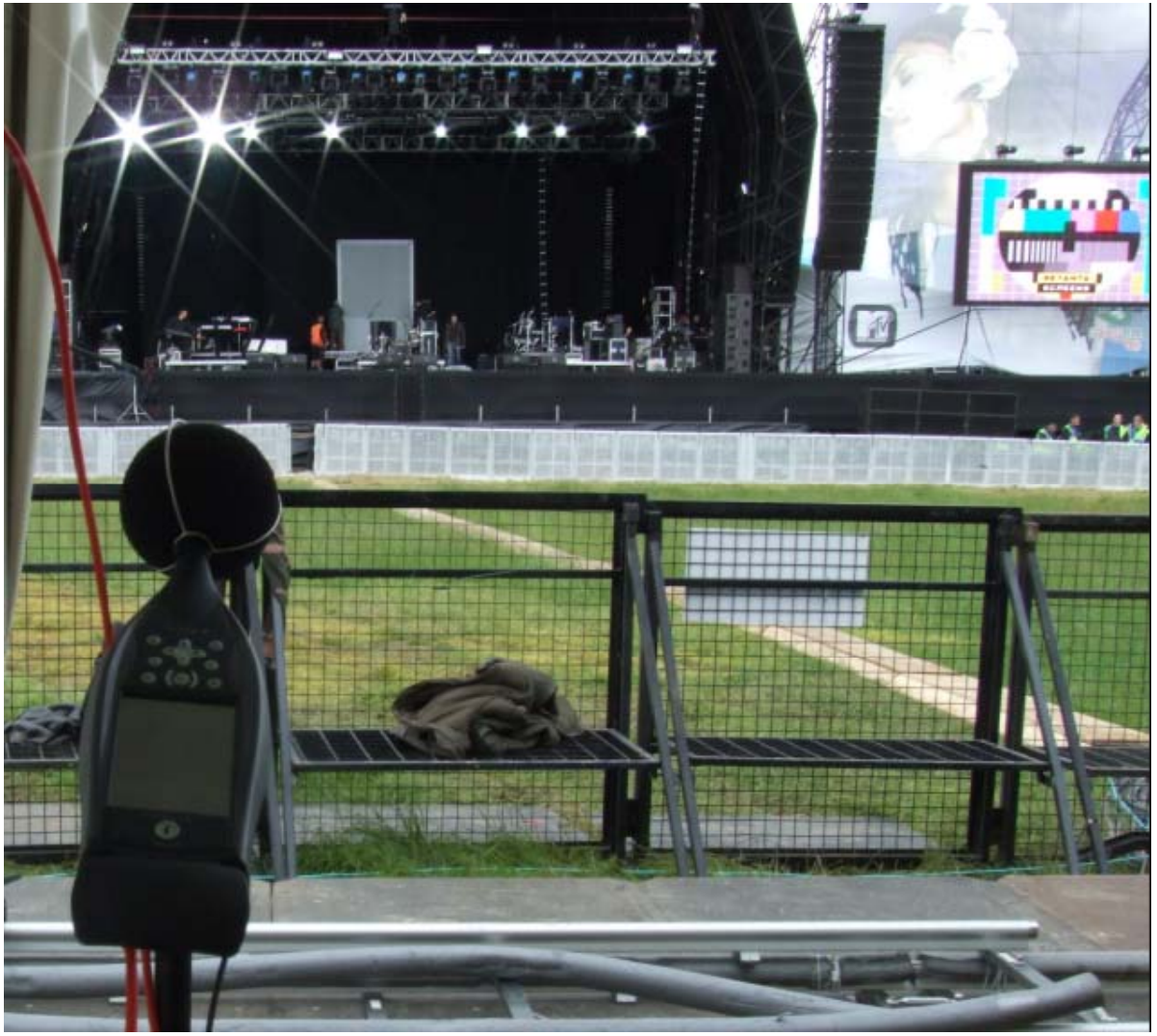
2250 properly mounted on tripod

Now the Noise Analyser meets the requirements of Class 1 of the Standard (BS EN 61672 Part 1, 2003)



Microphone positioning

Microphone positioning



Microphone positioning

- It can be difficult to position the microphone in an ‘acoustically correct’ position at the mixing desk position.

- However the results can still be useful, so long as the position is used for comparison / correlation.

  – Carry out a sound test prior to each event to ascertain the maximum level that can prevail at the monitoring position to enable the guidelines to be met.

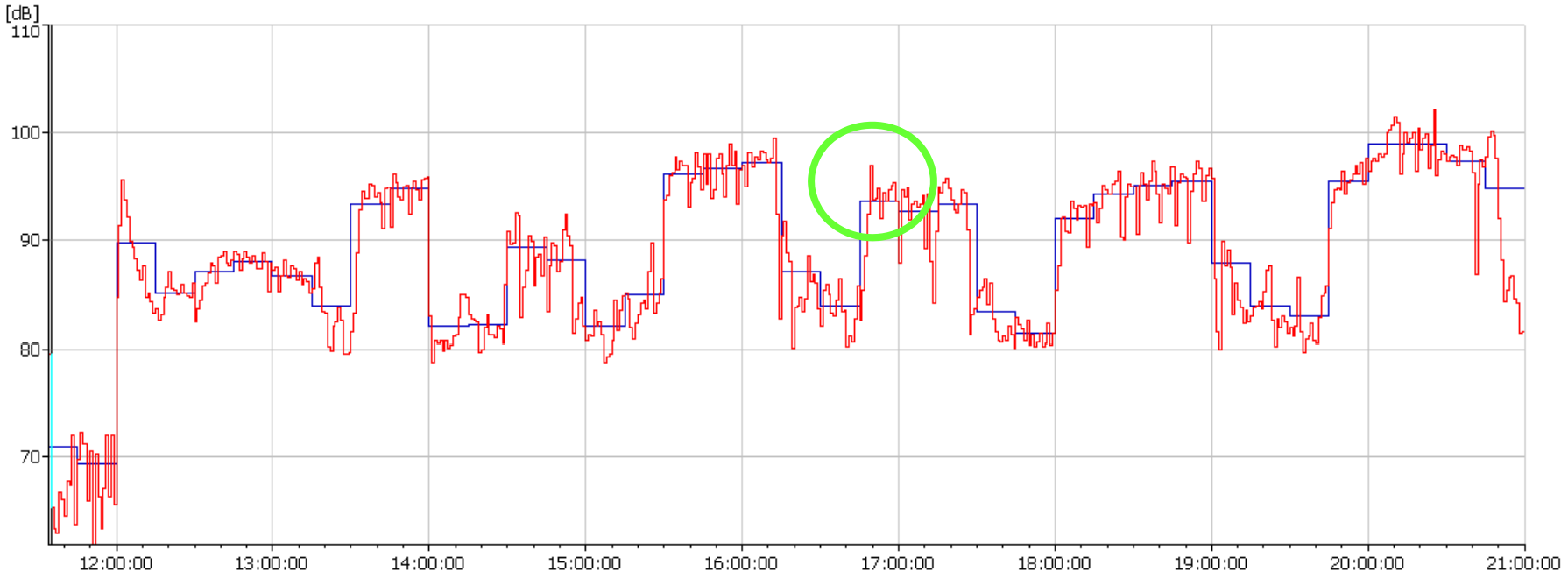
  – This effectively calibrates the system, taking into account as far as possible prevailing weather conditions, and, for indoor events, the sound insulation of the venue.

15 min and 1 min measurement periods

- Although the limit value set at 4.8 above would be in terms of 15 minute LAeq, useful control can be exercised by monitoring the LAeq over one minute periods. This enables an early warning to be obtained of possible breaches in the 15 minute limit.

  – Some sound level meters are able to carry out both functions simultaneously, i.e. measure two concurrent LAeq periods.

1 min and 15 min measurement periods



How accurate are your measurements

- Whenever a measurement is made, there will be a degree of uncertainty *(often ignored in acoustics)*
- This is due to a number of factors

- *A Good Practice Guide on the Sources and Magnitude of Uncertainty Arising in the Practical Measurement of Environmental Noise*

  – N J Craven, G Kerry 2001

Accuracies of Sound Level Meters

At Reference Conditions of:

① 20°C air temperature **AND** 65% relative humidity **AND** ③ 1013 mbars atmospheric pressure **AND** ④ 0° incidence sound waves at 1KHz **AND** 94dB sound pressure level.

At these exact conditions, accuracies (were):

BS EN 60651 : 1994

Type	0	1	2	3
Accuracy	± 0.4dB	± 0.7dB	± 1.0dB	± 1.5dB

New standard for sound level meters

- IEC 61672-1 : 2003 - new standard
- No longer an overall statement of accuracy (although reference conditions still apply).

- Measurement uncertainty; (separate to uncertainty of SLM).
  - With short term assessments of the LAeq of a stable, continuous source, at close range, under favourable meteorological conditions, without noticeable residual sound
  - Overall combined uncertainty of 3dB (this is an example figure).
- Have SLMs got less accurate? No!
  - Guidelines for assessing uncertainty have got better
  - ISO 1996-2 : 2007
- 3 dB estimate above relates to LAeq, higher uncertainties to be expected for frequency band levels.

Uncertainty in ISO 1996-2 : 2007

Standard uncertainty due to instrumentation [1] in dB	Standard uncertainty due to operating conditions [2] in dB	Standard uncertainty due to weather and ground conditions [3] in dB	Standard uncertainty due to residual sound [4] in dB	Combined standard uncertainty σ_t in dB	Expanded measurement uncertainty in dB
1,0	X	Y	Z	$\sqrt{1{,}0^2 + X^2 + Y^2 + Z^2}$	$\pm 2\ \sigma_t$

1. For IEC 61672 Class 1 instrumentation. If other instrumentation (IEC 61672 class 2 or IEC 60651/60804 type 1 sound level meters) or directional microphones are used, the value will be larger
2. To be determined from at least 3, and preferably 5 measurements under repeatability conditions (the same measurement procedure, the same instruments, the same operator, the same place) and at a position where variations in meteorological conditions have little influence on the results. For long-term measurements more measurements will be required to determine the repeatability standard deviation. For road traffic noise some guidance on the value of X is given in 6.2.
3. The value will vary depending upon the measurement distance and the prevailing meteorology. A method using a simplified meteo window is provided in Annex A (in this case $Y = \sigma_m$). For long-term measurements different weather categories will have to be dealt with separately and then combined together. For short-term measurements variations in ground conditions will be small. However, for long-term measurements, these variations may add considerably to the measurement uncertainty.
4. The value will vary depending on the difference between measured total values and the residual sound

Low frequencies

- From Craven and Kerry, 2001

- Low frequencies (<100 Hz) are notoriously difficult to measure; levels often fluctuate dramatically and may be affected by:
  - Standing waves
  - High background levels
  - Wind noise
  - Structure/ground borne vibration
  - Beating between similar sources

- Good practice
  - **“Anticipate significant levels of uncertainty when measuring noise at the extremes…. i.e. below 125 Hz or above 4 kHz”**

Uncertainty

- " I measured an $L_{Aeq,\ t}$ of x dB (+/- y dB) with z % level of confidence"
  - Eg L_{Aeq} = 75 dB (+/- 3 dB) at 95% level of confidence
- **A Beginner's Guide to Uncertainty of Measurement,** Stephanie Bell

Open questions

- How many dB exceedences would be a breach?
- How many instances of exceedence would be a breach?
- Does anyone have a policy on these questions in terms of enforcement?

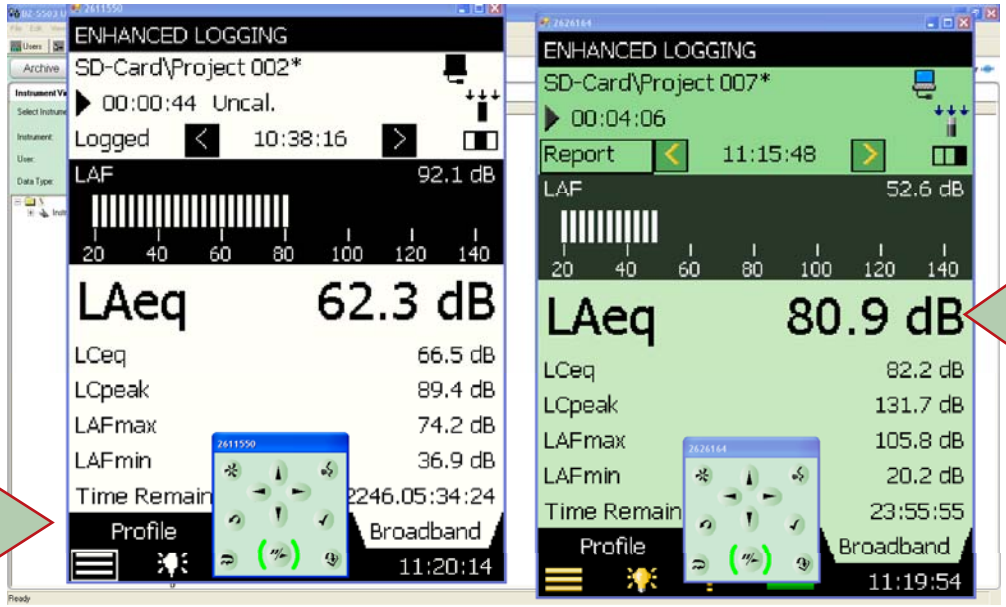
Concert noise monitoring

"Correlation"

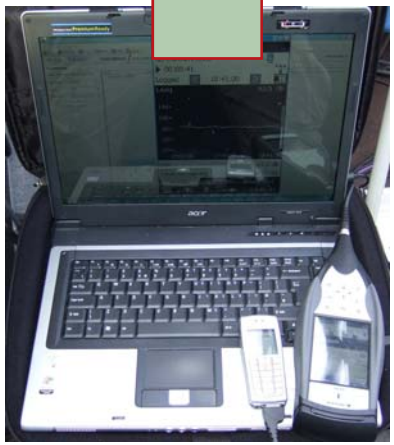
E.g. 20 dB

Simultaneous Noise Monitoring

Remote



Local



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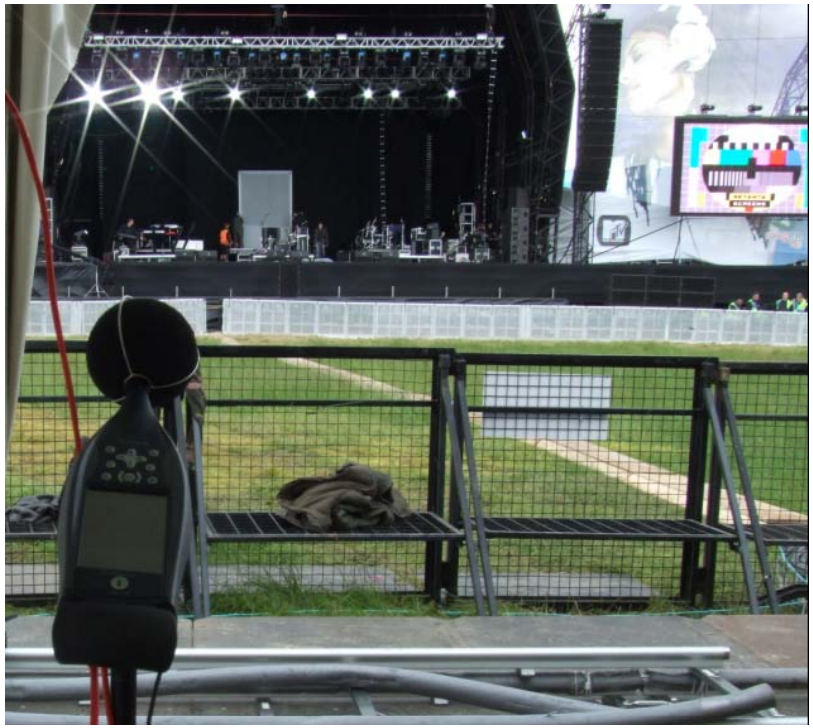
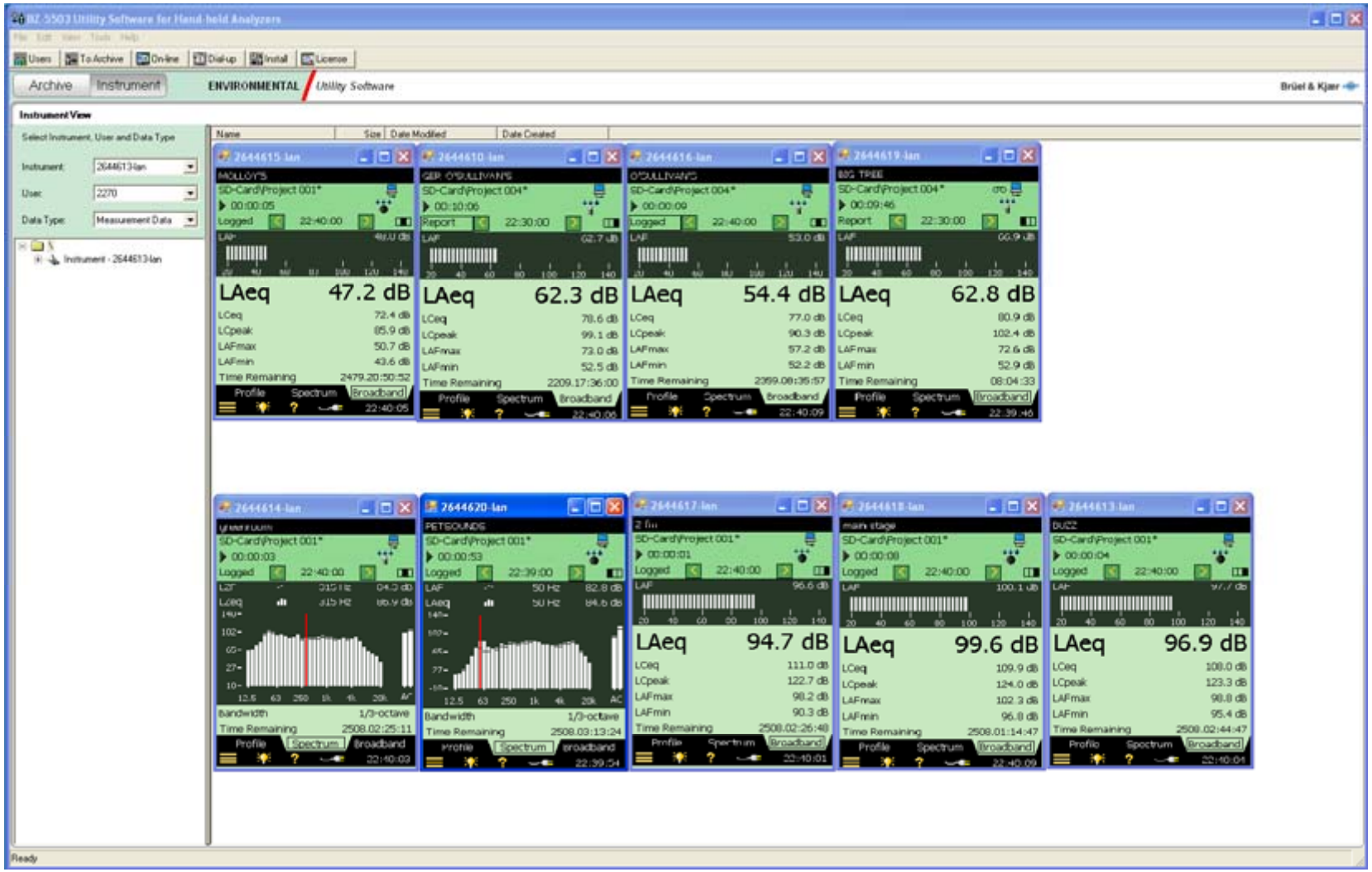


Oxegen - Dublin



The end

- Thank you for listening
- Any questions?