Sustainable
Mobile
Fencing &
Security

On-Site Test Report

Investigation of sound pressure levels with fence panels in the sound path both plain / untreated and using NCB 2.0 and NCB acoustic barriers

HERAS

1. Introduction

Heras Mobile Fencing & Security requested a site visit to access the performance of the Noise Control Barrier and Noise Control Barrier 2.0. These acoustic fence barriers will be named NCB and NCB 2.0 in this test report. The test was carried out at Heras premises in Pelt, Belgium and should be considered ad-hoc. The test was carried out by Heras in cooperation with the manufacturer of the acoustic fence barriers.

2. Aims and Objectives

Initial evaluation by Heras Mobile Fencing & Security on the new NCB 2.0 using a dB meter showed mixed results. After some communications it was agreed and measure the sound pressure levels for the fence panels in a 'square' (fully enclosed) 'C' (enclosed on 3 sides) and line formations on site, with both the NCB 2.0 and NCB for comparison, both on the sound source side of the barrier and the other side. The measurements should be taken at 12.5Hz to 16,000Hz and recorded for input in to a spreadsheet. The results of the tests are to be discussed and entered into a spreadsheet and compared / assessed.

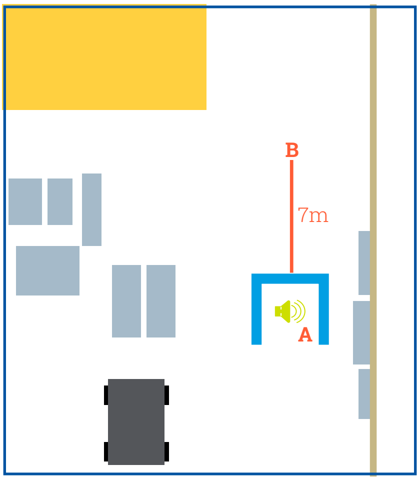
3. Equipment / Instrumentation

- Sound Level Meter — Type 1
- SLM type — Rion NL32
- SLM serial number — 00630462
- Calibrator type — Rion NC74
- Calibrator serial number — 00720390
- MIC type — UC 53A
- MIC serial number — 318323
- Pre Amp — NH-21
- Pre Amp serial number — 08160
- Microphone windshield
- CD player with White Noise CD
- Power Amp and Speaker
- Log book and Pencil

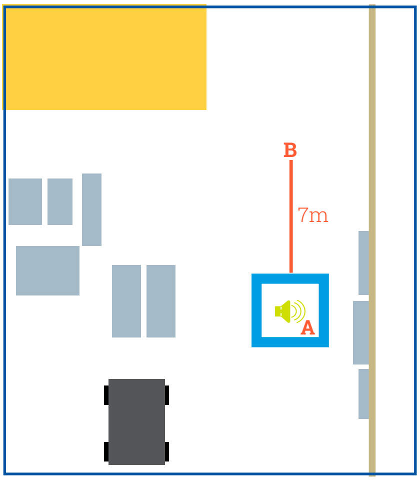
4. Method

The Sound Level Meter (SLM) was set up, batteries tested, 'F weight' set to Flat, 'T weight' set to 'Fast', 'Set' time to 10 seconds and 'Range' to 120 dB, LEQ, 1/3 Octave and Linear plus 'A' Weighted values. The SLM was then calibrated.

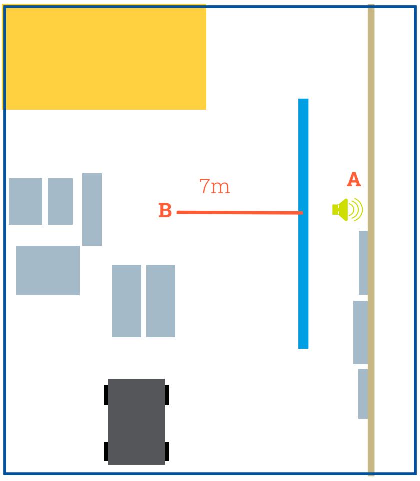
The 3 main layouts for the testing is as below, Layout 1 - 3 sided fence, Layout 2 – 4 sided fence, Layout 3 – Linear fence.



Layout 1



Layout 2



Layout 3

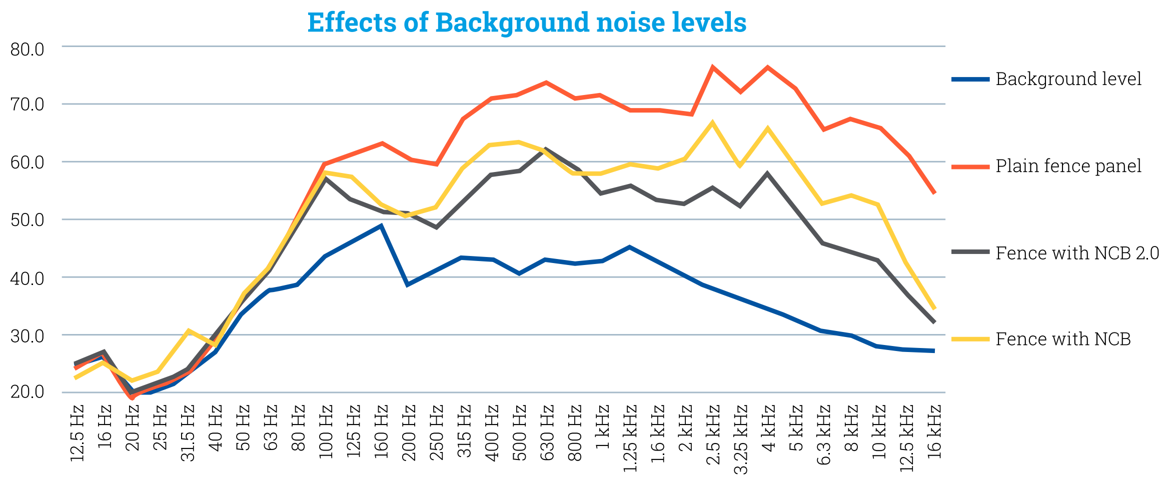
Measurement locations were selected and marked 'A' 1m from the sound source and 'B' 7m from the fence line. Background noise levels were measured at locations A and B on Layouts 1 & 2 and showed 56.4 dB(A) for position 'A' and 54.5dB(A) for position 'B' and were recorded, including 1/3rd octave results (measurement results 1 and 2). A further 15 measurements were taken (measurement results 3-17). For the range of locations and set-ups, see section 5. Upon completion of all measurements for all environments the data was then downloaded on to a computer via the memory card into a spreadsheet for plotting onto graphs for evaluation of results.

5. Results

¹⁄₃rd octave data, octave data and Leq [dB(A)] for all 17 results have been recorded, the table below shows the octave and dB(A) results. All graphs are using the ¹⁄₃rd octave data.

Adress	Test Ref	Description	Layout Type	dB(A)	Octave Band Data (1/1)									
					16Hz	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
1	A1	Background A	Layout 1	56.4	23.8	23.8	37.1	46.7	41.7	42.5	43.7	40,7	34,7	29,7
2	B2	Background B	Layout 1	54.5	23.4	23.9	35.4	45.6	41.3	40.5	38.0	35.0	30.5	27.8
3	A3	Plain Fence 3 sided A	Layout 1	82.1	24.0	26.8	51.8	70.4	65.4	67.2	70.7	69.1	68.4	56.0
4	B4	Plain Fence 3 sided B	Layout 1	84.6	23.7	24.9	43.3	61.7	63.0	72.4	70.8	71.3	74.2	66.6
5	A5	Fence with NCB 2.0 3 sided A	Layout 1	92.4	24.0	29.8	50.8	71.2	75.4	80.8	79.5	80.5	80.9	72.9
6	B6	Fence with NCB 2.0 3 sided B	Layout 1	69.3	24.3	25.4	42.6	54.2	51.0	59.7	56.8	54.0	54.4	44.6
7	A7	Fence with NCB 2.0 4 sided A	Layout 2	95.2	24.3	30.7	53.6	70.5	79.2	82.8	81.5	84.5	82.3	75.6
8	B8	Fence with NCB 2.0 4 sided B	Layout 2	73.4	23.7	25.5	41.1	62.9	56.5	62.2	58.7	59.1	58.3	47.2
9	A9	Fence with NCB 2.0 Line A	Layout 3	88.9	23.1	25.2	51.8	69.9	69.3	73.1	75.3	76.3	77.8	69.9
10	B10	Fence with NCB 2.0 Line B	Layout 3	70.8	23.9	25.6	41.8	53.6	51.6	54.5	57.3	61.8	57.4	51.3
11	A11	Fence with NCB Line A	Layout 3	88.7	24.1	27.2	51.4	69.8	68.8	71.6	72.0	76.1	79.2	68.7
12	B12	Fence with NCB Line B (small gap)	Layout 3	74.7	23.7	26.2	41.8	56.1	54.6	59.4	58.1	66.3	60.9	54.0
13	B13	Fence with NCB Line B	Layout 3	72.1	23.8	27.2	44.4	55.8	54.3	60.9	58.2	61.8	57.7	47.3
14	A14	Fence with NCB 3 sided A	Layout 1	89.8	24.2	29.2	52.0	71.7	72.3	74.8	73.6	78.3	78.6	70.2
15	B15	Fence with NCB 3 sided B	Layout 1	74.3	23.6	28.0	43.6	56.3	54.1	63.0	58.8	62.4	62.0	53.3
16	A16	Fence with NCB 4 sided A	Layout 2	90.8	24.5	31.2	53.0	69.1	75.2	76.0	75.1	79.2	80.2	71.9
17	B17	Fence with NCB 4 sided B	Layout 2	75.2	24.3	27.7	42.5	61.7	56.4	63.3	59.0	62.8	63.0	54.4

Test results 1 & 2 are Background Noise Levels at locations A & B. Generally noise levels of greater than 10dB above background noise levels are required to not be affected or influenced by background noise. The graph below shows some example results against background levels.



Based on the above, results below 63Hz should be ignored due to background contamination.

5.1 Information

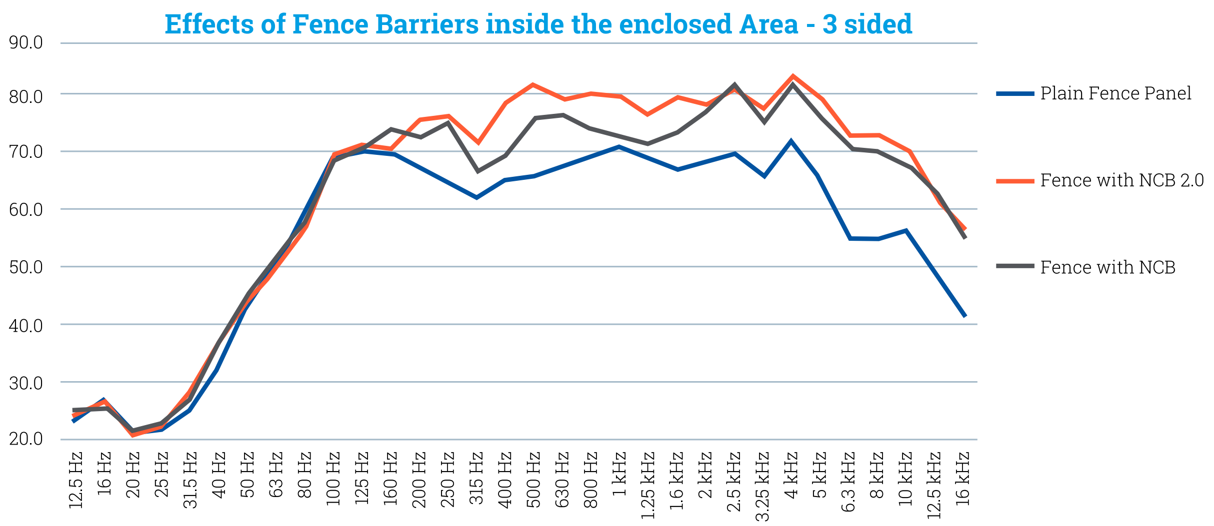
The 2 main types of acoustic fence barriers available are the original NCB, which comprises of a lower mass barrier, but includes for a soft sound absorption material to one side, the newer NCB 2.0 comprises of a higher mass and no sound absorption to one side. The theory is that in the most common application of closing off larger areas, the newer NCB 2.0 fence barrier would offer higher 'Sound Reduction Indexes'. However for 'close-up' enclosures on 3 or 4 sides, where the sound source is closer to the fence line, sound levels on the source side of the barrier may increase slightly, but should still offer better performance on the other side and therefore may only be an issue where workers are inside the enclosure and the sound levels are sufficient to be a concern with the 'Noise at Work Regulations'.

There are 3 main methods of examining the results, a) the laboratory tested results for the 'Sound Reduction Index' (SRI) of the barriers b) the on-site 'Sound Reduction Index' (SRI) of the barriers, which would compare the increased level on the source side with the sound levels at a predetermined distance from the fence and c) the 'Insertion Loss' (IL) which compares the original sound levels without any barriers (NCB or NCB 2.0) and the results once the barriers have been installed. This latter IL value is considered by Heras Netherlands as the most important as this would represent 'real world' conditions.

The following results will assess noise levels close to the source, inside the fence line for the 3 layouts, 7m from the fence line away from the noise source for both dB(A), SRI and IL.

5.2 Noise levels inside the 3 sided area (3, 5 & 14)

For tests 3, 5 & 14, location A, Layout 1 the sound source was run without any linings (3), with the NCB 2.0 (5) and NCB (14).

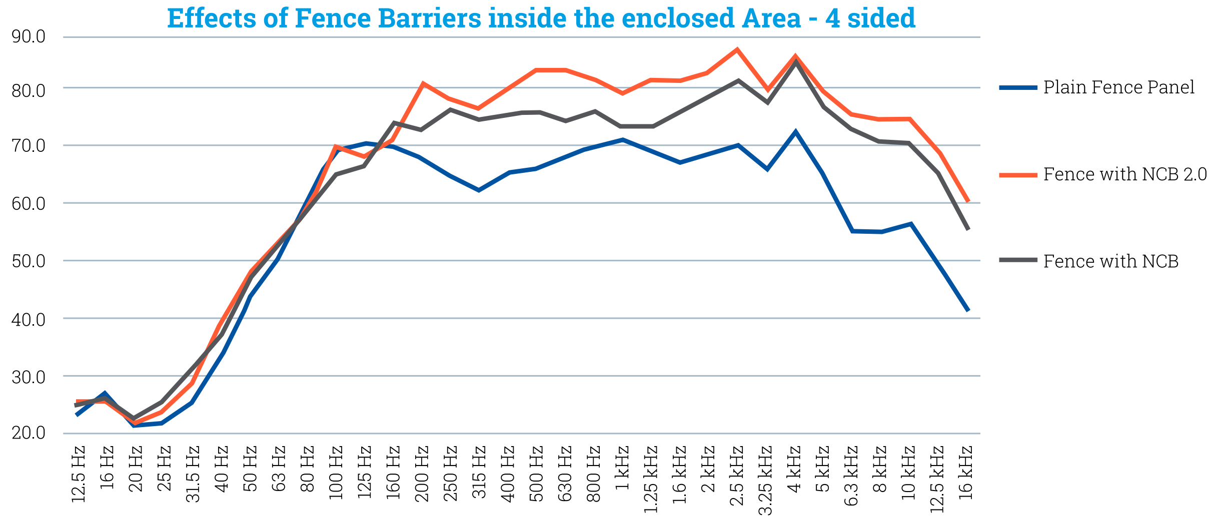


The results above show that the sound levels without any barriers measured 82.1dB(A) and when the NCB 2.0 was installed this increased to 92.4dB(A) and with the NCB installed it increased to 89.8dB(A). This clearly shows that partially enclosing a sound source will increase the sound levels inside the area. This is due to the receiver being subjected to both direct sound and reflected sound energy from 3 sides. With the NCB 2.0 this showed a 10.3dB increase, with the NCB this showed a 7.7dB increase. The difference in increases is undoubtedly due to the sound absorption layer within the NCB product, however both showed as expected a notable increase. The difference between the NCB 2.0 and NCB however was only 2.6dB, which is generally considered small, indeed the human ear cannot detect less than 3dB change in sound pressure levels.

It should also be noted that the dB(A) is a weighted average across all frequency bands. The above graph shows almost no difference between all 3 values below 200Hz and almost no difference between the NCB 2.0 and NCB above 2KHz. The slight variations between the 2 barriers seem to occur only between 315Hz and 1.6KHz.

5.3 Noise levels inside the 4 sided area (3, 7 & 16)

For tests 3, 7 & 16, location A, Layout 2 the sound source was run without any linings (3), with the NCB 2.0 (7) and NCB (16).

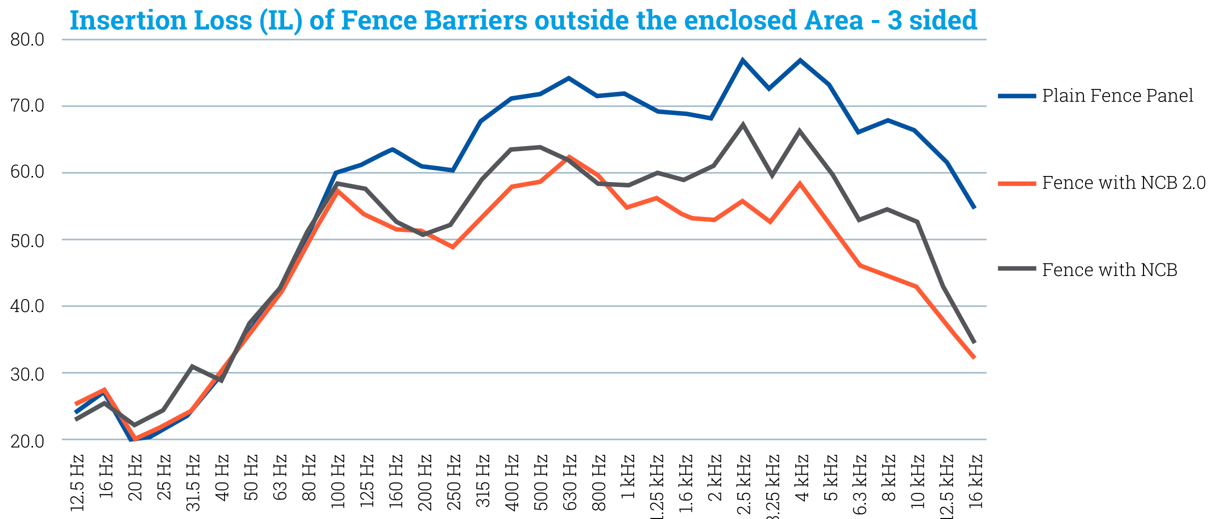


The results above show that the sound levels without any barriers measured 82.1dB(A) and when the NCB 2.0 was installed this increased to 95.2dB(A) and with the NCB installed it increased to 90.8dB(A). This clearly shows that fully enclosing a sound source will increase the sound levels inside the area. This is due to the receiver being subjected to both direct sound and reflected sound energy from all 4 sides. With the NCB 2.0 this showed a 13.1dB increase, with the NCB this showed a 8.7dB increase. The difference in increases is undoubtedly due to the sound absorption layer within the NCB product, however both showed as expected a notable increase. The difference between the NCB 2.0 and NCB was 4.4dB.

It should also be noted that the dB(A) is a weighted average across all frequency bands. The above graph shows almost no difference between all 3 values below 160Hz and almost no difference between the NCB 2.0 and NCB above 3.15KHz. The slight variations between the 2 barriers seem to occur only between 400Hz and 2.5KHz.

5.4 Insertion Loss (IL) 7m from 3 sided area (4, 6 & 15)

For tests 4, 6 & 15, location B, Layout 1 the sound source was run without any linings (4), with the NCB 2.0 (6) and NCB (15).

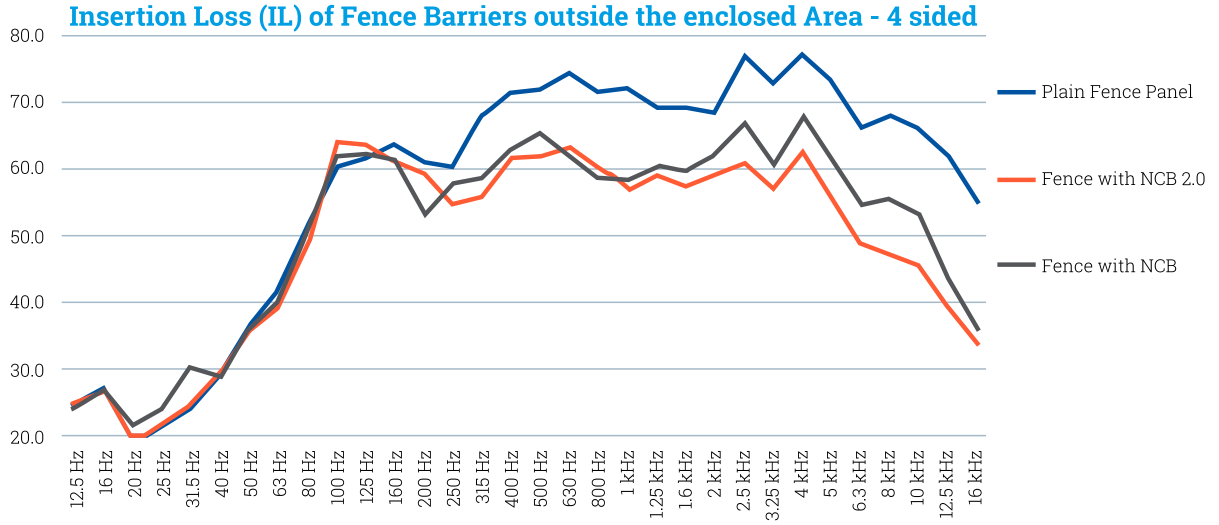


The results above show that the sound levels without any barriers measured 84.6dB(A) and when the NCB 2.0 was installed this reduced to 69.3dB(A) and with the NCB installed it reduced to 74.3dB(A). This clearly shows that using acoustic barriers on 3 sides of the sound source offered significant improvement. With the NCB 2.0 this showed a 15.3dB reduction, with the NCB this showed a 10.3dB reduction. The difference in the Insertion Loss is undoubtedly due to significant additional mass of the NCB 2.0, however both showed a good level of reduction as expected. The difference between the NCB 2.0 and NCB however was 5dB, this is considered as a 25% improvement in perceived loudness.

It should also be noted that the dB(A) is a weighted average across all frequency bands. The above graph shows almost no difference between all 3 values below 125Hz, however values above this show a clear improvement of both barriers and between 315Hz and 12.5KHz clearly show the benefits of the NCB 2.0 over the NCB at these frequency bands.

5.5 Insertion Loss (IL) 7m from 4 sided area (4, 8 & 17)

For tests 4, 8 & 17, location B, Layout 2 the sound source was run without any linings (4), with the NCB 2.0 (8) and NCB (17).

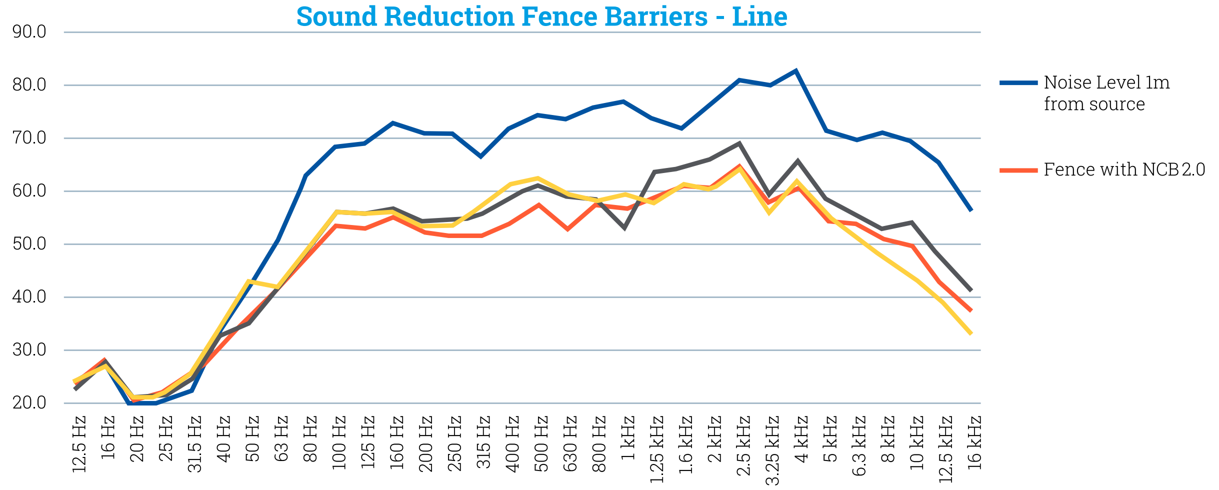


The results above show that the sound levels without any barriers measured 84.6dB(A) and when the NCB 2.0 was installed this reduced to 73.4dB(A) and with the NCB installed it reduced to 75.2dB(A). This clearly shows that using acoustic barriers on all 4 sides of the source offered significant improvement. With the NCB 2.0 this showed a 11.2dB reduction, with the NCB this showed a 9.4dB reduction, the difference in the Insertion Loss between the NCB 2.0 and NCB however was only 1.8dB. This would suggest that in a 4 sided enclosure both types of barrier would offer similar results.

It should also be noted that the dB(A) is a weighted average across all frequency bands. The above graph shows almost no difference between all 3 values below 200Hz, however values above this show a clear improvement from both barriers, albeit the NCB 2.0 only shows marginal improvement above the NCB.

5.6 Sound Reduction Index 7m from Line of Fence Panels (9, 10, 12 & 13)

For tests 9, location A and 10, 12 & 13, location B, Layout 3 the sound source was run, measurements inside the fence line (A9), and outside from 7m away with the NCB 2.0 (B10) and NCB with a small gap in the mid-section (B12) and with gap closed (B13).



The results above show that the sound levels inside the fence line with the NCB 2.0 barrier measured 89.9dB(A) and from 7m from the fence line, location B with the NCB 2.0 in place this was reduced to 70.8dB(A) and with the NCB installed it reduced to 74.7dB(A) with a small gap and 72.1dB(A) with the gap closed. This shows a reduction with the NCB 2.0 of 18.1dB and, with the NCB this showed a 14.2dB to 16.8dB reductions. The difference in the sound reduction indexes between the NCB 2.0 and NCB however was only 1.3dB. This would suggest that in a line or a non-close enclosure both types of barrier would offer similar results.

It should also be noted that the dB(A) is a weighted average across all frequency bands. The above graph shows almost no difference between all 3 values below 50Hz, however values above this show a clear improvement from both barriers.

5.7 table of results, Laboratory, SRI and IL

Laboratory results to EN ISO 10140:2

NCB 2.0	23dB Rw
NCB	17dB Rw
Difference	6dB

SRI (increased levels at A minus levels at B)

NCB 2.0	(A5-B6)	23.1dB
NCB 2.0	(A7-B8)	21.8dB
NCB 2.0	(A9-B10)	18.1dB
NCB	(A14-B15)	15.5dB
NCB	(A16-B17)	15.6dB
NCB	(A11-B13)	16.6dB
Difference	**(Ave)**	5.1dB

Insertion Loss (levels at B with the insertion of the NCB 2.0 and NCB)

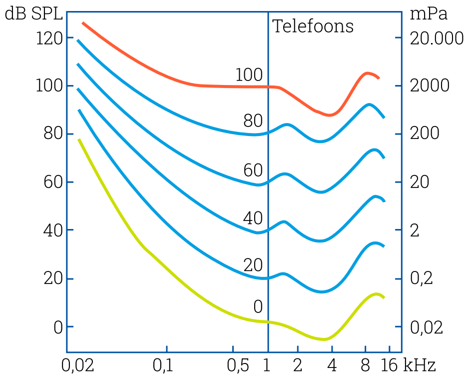
NCB 2.0	(B4-B6)	15.3dB
NCB 2.0	(B4-B8)	11.2dB
NCB	(B4-B15)	10.3dB
NCB	(B4-B17)	9.4dB
Difference 3 sided		5dB
Difference 4 sided		1.8dB
Difference (Ave)		3.4dB

6. Discussion

The following discussion points would be advised.

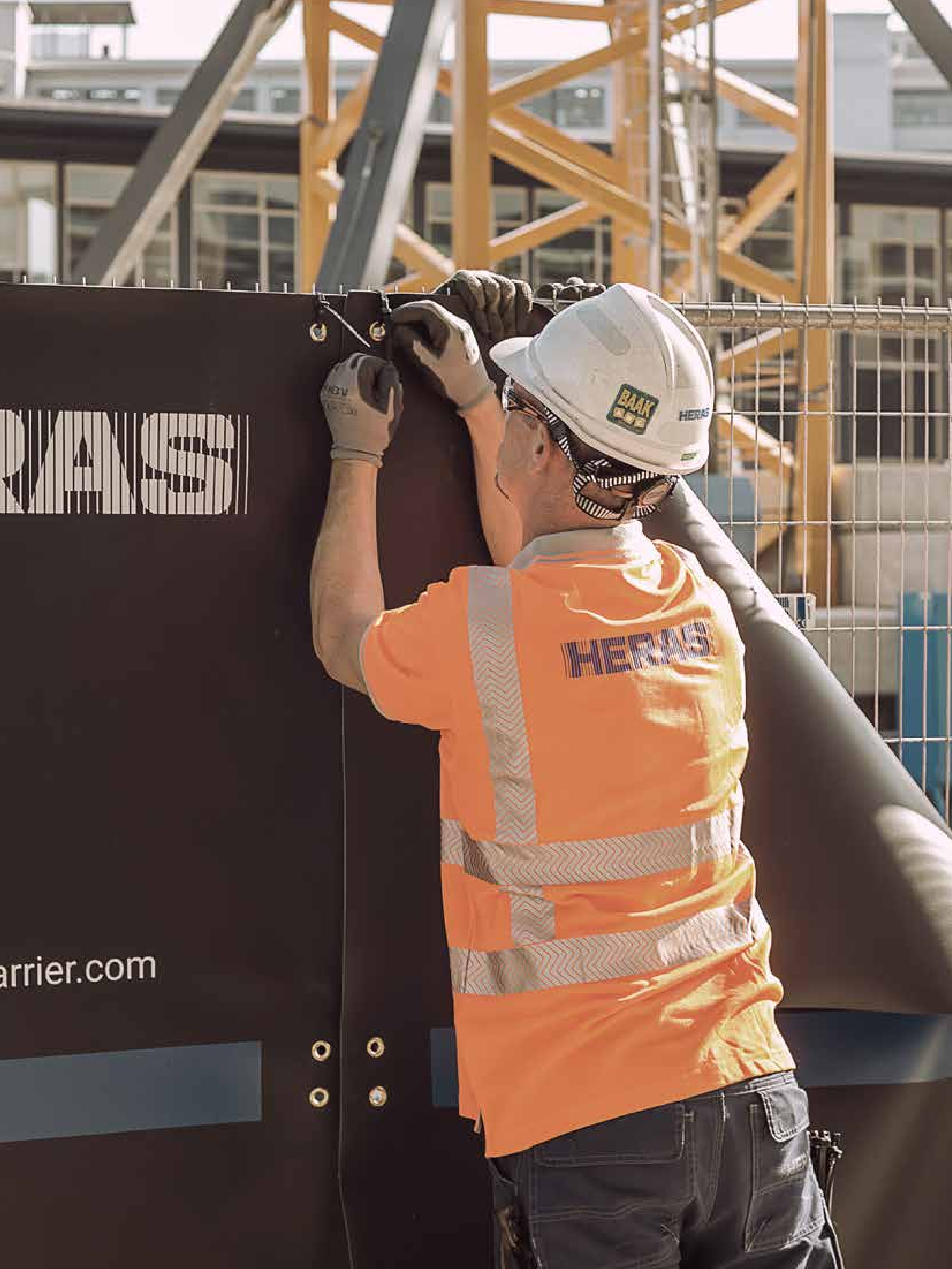
An overall dB(A) measurement is an 'A' weighted average across all frequencies and whilst sometimes it only showed a small change between the barriers, the effect at the 1/3rd octave bands, especially in the important mid to high frequencies were far more significant, up to 10dB.

The human response to sound is not linear at all frequencies, for example a 20dB noise level at 1000Hz is considered the same as 90dB at 25Hz.
These values are shown in 'Equal Loudness Contours' (see right) therefore any improvements at the 500Hz-4000Hz are considered important.



The laboratory measured values show the NCB 2.0 at 23dB Rw and the NCB at 17dB Rw. The field measurements showed the NCB 2.0 achieved an average of 21dB and the NCB an average of 16dB, so similar to the laboratory measured values. The Insertion Loss (IL) values, which ignore the increase in localised levels and considered more meaningful by Heras Netherlands, achieved an average of 13dB for the NCB 2.0 and an average of 10dB for the NCB. We would additionally note the NCB 2.0 offered much higher values (15dB improvement overall, 5dB more than the NCB) when the sound source was not fully enclosed on all 4 sides in close proximity. This is considered as a 25% improvement in perceived loudness.

When the sound source is fully or partially enclosed, as expected the sound pressure levels inside the enclosure increased. With the NCB 2.0 this showed a 10 to 13dB increase, with the NCB this showed a 8 to 9dB increase. The difference in increases is undoubtedly due to the sound absorption layer within the NCB product, however both as expected showed a marked increase. The difference between the NCB 2.0 and NCB however was only 2 to 4dB.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7. Conclusion

The general results, even using the lower value of the 'Insertion Loss' figures, would suggest that the NCB 2.0 offers improved performances over the NCB barrier on applications where the sound source is surrounded by a line of fence panels and/or smaller 3 sided enclosures where the open end would be facing away from the nearest sound sensitive areas. For 4 sided small enclosures the performance for both were very similar, therefore in respect to conditions where the treated fence panels are in the 'line of sight' between the sound source and the receiver, the NCB 2.0 should be considered the better option from an acoustic perspective, with up to 25% improvement (5dB) in overall perceived loudness and more than 12dB at some frequencies.

The results from inside a small enclosure (3 panels, 3 sided or 4 panels, 4 sided) would suggest that both the NCB 2.0 and the NCB increase the local sound pressure levels, more so on the 4 sided than the 3 sided, albeit on the 3 sided this difference is fairly small. Therefore it would suggest that if there are workers inside the enclosed space and the enclosure is on all 4 sides, then the NCB may prove to be the better option. However if the enclosure was either 3 sided, or a larger 4 sided enclosure (8 panels, 4 sided or greater) then either barrier would likely prove suitable. The NCB 2.0 however would offer the additional benefit of higher performance outside the enclosure.

This report looks only at the acoustic performance and does not include any considerations for any other possible advantages/disadvantages between the two options (NCB 2.0 and NCB), such as cost, robustness of barrier, handling, commercial, application etc.

Appendix – Images

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