USING CSA STANDARD Z107.56 TO INVESTIGATE NOISE EXPOSURE OF CALL CENTRE EMPLOYEES

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1 Introduction

A study was performed to measure the noise exposure of call centre employees working in a new LEED Platinum office space that is equipped with low-height partitions and minimal acoustical treatments. Due to the nature of the acoustical environment, complaints of excessive noise have arisen along with concerns of health and safety noise impacts. The noise exposure of the employees was measured and compared with criteria in B.C. Reg. 382/2004 [1], following the guidelines of CSA Standard Z107.56 [2], as required by B.C. Reg. 382/2004. The B.C. Reg. states that an employer must ensure that a worker is not exposed to noise levels above either of the following exposure limits: 85 dBA Lex daily noise exposure level and 140 dBC peak sound level.

The study involved performing unattended background noise monitoring within the call centre area as well as measuring the noise contribution of the call centre employees' headsets using a Head and Torso Simulator (HATS) manikin.

2 Method

2.1 Background Noise Monitoring

Background noise monitoring was performed to determine the ambient noise within the call centre. A Brüel & Kjær 2250 Type 1 integrating Sound Level Meter (SLM) was set up within the call centre at one of the desks, chosen due to its central location of the largest open area of the call centre. The height of the microphone was set at 1.1 m to represent the height of a typical seated worker. Sound levels were logged every minute during the monitoring period. Monitoring occurred over a 24 hour period and was recorded to allow for post-measurement data review.

2.2 Headset Measurements

Measurements of sound levels from a typical call centre headset were performed following the guidelines of Section 7.3.2 in CSA Z107.56-13. A manikin (Brüel & Kjær Type 4128C HATS) with microphones at its eardrums was set up in the chair of the same desk where the monitoring was performed and connected to the SLM.

As the phone system had multiple volume controls, each setting was verified by a call centre employee. Once the volume setting was adjusted to the maximum level, just below the sound level where clipping and/or distortion in the headset started to occur, the headset was carefully placed on the manikin. Since the manikin microphones were connected to the SLM, it was possible to monitor the manikin signal from a secondary headset connected to the SLM. The placement of the headset on the pinna of the manikin was carefully checked and adjusted until good coupling was achieved, as observed visually and through monitoring with the secondary headset.

With the headset installed on the manikin, a set of three scripted test calls were acted out by Golder staff so that the microphones in the manikin's ears would receive a realistic signal (using actual calls was not possible with the current call centre equipment). The scripts consisted of typical call centre conservations with a calm tone, a medium tone, and an elevated tone. This was done to determine the variation in call sound level that might occur due to the type of conversations that may be expected.

In the call centre, Golder staff spoke into the headset microphone on the manikin and listened through a secondary headset connected to the SLM. Using the call centre phone system, calls were placed and received to Golder's office where Golder staff first used a typical office phone in a quiet meeting room followed by a cell phone next to a busy roadway. The purpose of these scenarios was to capture the variation in call sound level that may be due to the customer's background sound level, type of phone used, and speaking environment.

Once the data was collected, it was processed following the CSA Z107.56 recommended procedure for converting the measured manikin eardrum sound pressure levels into diffuse field equivalent sound pressure levels. The conversion is required for proper comparison to the applicable 85 dBA criterion. The 'long method' was utilized based on one third octave band data. It should be noted that the CSA Z107.56 standard does not provide any guidance on eardrum-to-diffuse field correction factors for peak sound levels for comparison against the 140 dBC criterion. Even so, the SLM only provides an overall C-weighted peak sound level (i.e. no peak spectrum data was available), which would make applying a correction difficult. Therefore, it was decided to report uncorrected eardrum measured peak C-weighted sounds levels, which represents a conservative assessment.

3 Results

3.1 Background Noise Monitoring

Based on a review of audio recordings, some of the 1 minute intervals during the monitoring period were excluded from analysis, due to call centre employees talking very close to the measurement microphone or making other anomalous noises. The time period from 7 pm to 6 am was also excluded

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since the call centre was closed and the lower noise levels were not representative of typical working conditions. Based on the valid 1 minute intervals, the sound level statistics summarized in Table 1 were calculated.

Table 1: Sound level statistics during the monitoring period.

Metric	SPL, dB, A or C Weighted
Min	41 dBA
L_{99}	44 dBA
L_{90}	48 dBA
L_{50}	53 dBA
L_{eq}	54 dBA
L_{10}	57 dBA
L_{1}	61 dBA
Max	63 dBA
Peak	108 dBC

3.2 Headset Measurements

The results of the headset measurements on the maximum volume level are summarized in Table 2 below.

Table 2: Headset call measurement results.

Caller Location	Script Tone	Diffuse-field SPL (L_{eq}, dBA)	Eardrum Peak SPL (Peak,
Quiet Office	Mild	74	110
Quiet Office	Medium	74	112
Quiet Office	Elevated	77	113
Busy Road	Mild	81	115
Busy Road	Medium	81	114
Busy Road	Elevated	83	116

For comparison against the applicable criterion of 85 dBA for an 8-hour average, a time-weighing correction must be applied based on the amount of time expected in each of the measured call scenarios. However, it can already be determined that since none of the scenarios were above 85 dBA, it is not possible for the resulting time-weighted average to exceed the 85 dBA criterion.

Since a breakdown of call types and caller noise environments was not provided, it was assumed that 90% of the calls had a mild / medium tone and 10% had an elevated tone, and that 75% of calls were made from a quiet environment and 25% from a loud environment. Based on these assumptions, the average call sound level was determined to be 78 dBA. It should be noted that even if 100% of the calls were made with an elevated tone and from a noisy environment using a cell phone, the average call sound level would still only be 83 dBA.

The average background noise level in the call centre was measured to be 54 dBA. During an 8-hour shift a typical call centre worker will spend up to 6 hours on calls, 1 hour on break, and 1 hour doing other activities such as computer work at their desk. Assuming that during the 2 hours not on calls the workers are exposed to a background noise level of 54 dBA and for the remaining 6 hours are exposed to average call sound levels of 78 dBA (assumed to be using the maximum volume setting), the daily noise exposure for a typical call centre worker (Lex, 8hr) is 76 dBA.

Reviewing the measured peak dBC weighted sound levels, the maximum peaks during the background sound level monitoring and headset measurements were 108 dBC and 116 dBC, respectively. It should be noted that the peak level from the headset measurements were not corrected using an eardrum to diffuse field transfer function and thus likely over-estimate actual noise exposure.

4 Discussion

Based on the measurement results and calculation of daily noise exposures, the 8-hour average and peak sound levels were found to be in compliance with B.C. Reg. 382/2004 criteria even when making conservative assumptions and with headsets on the maximum volume setting.

According to CSA Z107.56, for effective communication a call's average sound level is typically required to be 15 dB above the background noise level. Based on the average background sound level of 54 dBA for the call centre, the minimum required sound level should be 69 dBA in order to provide at least a 15 dB signal-to-noise ratio. As reported in Table 2, the minimum measured average call sound level was 74 dBA, which is 5 dB higher than expected for effective communication. This suggests this assessment represents a conservative analysis, as even for quieter calls a 5 dB lower volume setting could have been used and would still allow for effective communication. This also suggests that CSA Z107.56's 'calculation method' to predict noise exposure of call centre employees based on measured background sound levels and an assumed 15 dBA signal-to-noise ratio could under-predict employees' noise exposure.

The CSA Z107.56 also provides a 'short method', which uses a single number correction when converting the eardrum sound levels to diffuse field sound levels, instead of using the third octave band corrections. It recommends subtracting 5 dB from the A-weighted eardrum sound level to derive the A-weighted diffuse field sound level. Using the third octave band corrections, the average difference between the diffuse field and eardrum sound levels measured here was 10.5 dBA. Therefore, using the 5 dB single number correction could over-estimate call centre employees' noise exposure.

5 Conclusion

An investigation related to noise exposure of employees in a new call centre was undertaken. Measurements of background noise within the call centre as well as the sound level generated by the call centre's headsets were performed. The investigation was performed in accordance with B.C. Reg. 382/2004 following the guidelines of CSA Standard Z107.56. Based on the results, the daily noise exposure of the workers was found to be less than the 85 dBA criterion and peak sound levels were found to be less than 140 dBC.

References

[1] Workers' Compensation Board. Occupational Health and Safety Regulation, B.C. Reg 382/2004. 2004.

[2] Canadian Standards Association. Measurement of Noise Exposure, CAN/CSA Z107.56-13. 2013.