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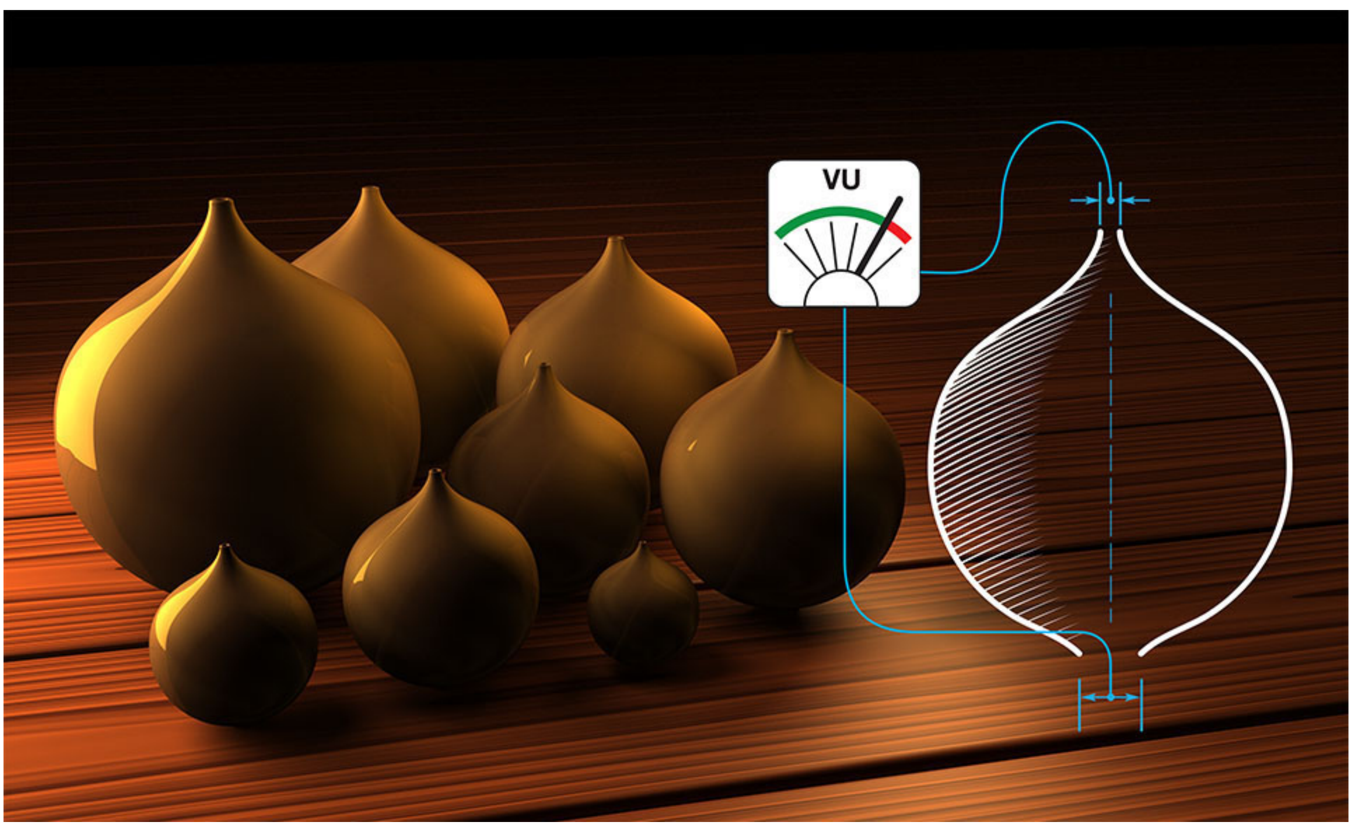

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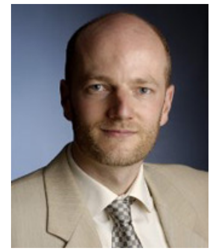
Acoustique canadienne est publié quantre fois par an, en mars, juin, septembre et décembre. Cette revue trimestrielle est envoyée gratuitement aux membres individuels de l'Association canadienne d'acoustique (ACA) et aux abonnés institutionnels. L'Acoustique canadienne publie des articles arbitrés et des rubriques sur tous les aspects de l'acoustique et des vibrations. Ceci comprend la recherche, les recensions des travaux, les nouvelles, les offres d'emploi, les nouveaux produits, les activités, etc. Les articles concernant les résultats inédits ou les applications de l'acoustique ainsi que les articles de synthèse, les tutoriels et les exposées techniques, en français ou en anglais, sont les bienvenus.L'Association canadienne d'acoustique a sélectionné Paypal comme solution pratique pour le paiement en ligne de vos frais d'abonnement. Paypal prend en charge un large éventail de méthodes de paiement (Visa, Mastercard, Amex, compte bancaire, etc) et ne nécessite pas que vous ayez déjà un compte avec eux. Si vous désirez procéder à un paiement par chèque de votre abonnement, on vous invite à compléter le formulaire d'adhésion et l'envoyer avec votre chèque ou mandat au secrétaire de l'association (voir adresse ci-dessus). - Canadian Acoustical Association/Association Canadienne d'Acoustique P.B. 74068 Ottawa, Ontario K1M 2H9 Canada - (613) 562-5248 - (613) 562-5800 p. 3066 - secretary@caa-aca.ca - Prof. Chantal Laroche

Éditorial
Editor's note



Le temps des changements

Ce numéro d'été est généralement un numéro spécial géré par le rédacteur en chef adjoint, avec des articles techniques en langue française. En raison de la disponibilité limitée d'articles en français, nous avons plutôt décidé d'aller pour un numéro régulier, d'où un autre éditorial de votre rédacteur en chef.

À première vue, ce numéro peut sembler léger, avec un nombre limité d'articles techniques. Cependant, ne vous méprenez pas, car deux des éléments publiés sont en fait des « Lettres au rédacteur », un exercice à la fois lourd et délicat, au cœur du processus d'arbitrage et de publication d'une revue scientifique. Les deux lettres ont été reçues par le rédacteur-en-chef, concernent "*Validation of the CSA Z107.56 standard method for the measurement of noise exposure from headsets*", G. Nespoli, A. Behar, F. Russo, Canadian Acoustics, Vol. 41, No. 3, pp. 31-36, 2013, et sont publiées intégralement pour votre examen attentif.

Enfin, je vous encourage à soumettre votre meilleur travail à notre revue Acoustique canadienne. Comme vous le savez peut-être, mes principaux objectifs sont d'accroître la qualité et l'impact de la revue, de réduire le temps d'attente pour les auteurs premières décisions, et de rendre le processus d'examen plus efficace et plus satisfaisante pour les auteurs et les arbitres.

Jérémie Voix
Rédacteur-en-chef

Changing Times

This summer issue is usually a special issue handled by the Associate Editor with technical articles in French. Because of the limited number of French articles received, we decided to go for a regular issue, hence another editorial from your Editor.

At first glance, this issue may appear like light reading, with only a few technical articles. But make no mistake, as two of the published items are actually "Letters to the Editor", heavy and delicate exercise which is at the heart of scientific journal reviewing and publication. The two letters have been received by the Editor, concern "*Validation of the CSA Z107.56 standard method for the measurement of noise exposure from headsets*", G. Nespoli, A. Behar, F. Russo, Canadian Acoustics, Vol. 41, No. 3, pp. 31-36, 2013, and are published unedited, for your perusal.

The templates for the journal articles and proceedings have also been updated and are hereafter presented, for your information.

Finally, I encourage you to submit your best work to Canadian Acoustics. As you may know, my primary goals are to increase the quality and impact of the journal, reduce the time authors wait for first decisions, and to make the review process more efficient and satisfactory for authors and reviewers.

Jérémie Voix
Editor

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For USB A/D Systems
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GEOMETRY EFFECTS ON THE NOISE REDUCTION OF HELMHOLTZ RESONATORS

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Abstract

The effect of geometry shape of the Helmholtz resonator on its resonant frequency and noise attenuation capability is discussed in this paper. The theory of resonant frequency depending on the shape of the vessel of the resonator is verified analytical and numerically using COMSOL for one degree of freedom resonators. The simulation was validated experimentally and has shown very good agreements. Various shapes of the resonators were compared in arrays. A better understanding of the shape effect is shown through simulations.

Keywords: Helmholtz resonators, noise reduction, conical resonators, spherical resonators

1 Introduction

Excessive noise generated by compressors and other turbo-machineries is a real concern in industries and refineries. The significant impact of this noise is the discomfort of the personnel working at the facility. In a couple of petroleum plants the authors have visited, the primary concern is that the noise of the compressors drowns the noise of the emergency alarms of the facility which sometime poses a serious safety issue. The next concern is the usual noise safety limitation for people working in the plant. The noise levels in compressors vary over a wide range from 70 – 120 dB [1, 2, 3]. As the compressor operates over its lifetime, the noise and vibration levels may expectedly increase, since centrifugal compressors are continuous flow machines and are extensively used in Saudi Arabia at crude oil processing facilities, maintenance is periodic and stopping the operation every time noise levels exceed the desired threshold can be very expensive. Currently Dresser-Rand compressors use customized Duct Resonator arrays (DR arrays) [1, 2].This solution was applied successfully to a 2528 PSIG (172 BARG) multistage centrifugal compressor on a platform in the North Sea and was shown to successfully give a reduction of up to 12 dB. Over the last few years, Dresser Rand has revamped more than 250 centrifugal compressors, both single stage and multistage [1,2], with the DR arrays. It appeared that reducing manufacturing cost can further increase the healthy margin of this product.

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2 Sources of noise in centrifugal compressors

Noise originates from various sources within compressors. The most critical source of noise in centrifugal compressors is considered to be the blade passing frequency noise. This noise arises from the interaction between the impeller blade and the stationary diffuser vanes [1, 2, 3]. It is widely known that Blade Passing Frequency (BPF) noise components originate from the circumferential flow distortions upstream and downstream of the impeller [6]. The interaction between the impeller blades as it passes by the stationary diffuser vane causes a pressure pulsation which leads to the development of positive and negative vortices.

The interaction of these vortices as they move along the flow path creates the discrete frequency noises of the blade passing frequency. Conventionally the BPF falls between 1000 Hz to 4500 Hz, usually depending on the speed of the compressor and the number of impeller blades [1].

This range falls within human hearing sensitivity which adds to the irritating nature of this noise. Although the BPF may be considered to be the most annoying aspect of compressor noise, at supersonic flow conditions another source of noise arises in the form of buzz saw noise. The BPF noise and the buzz saw noise coupled together can lead to structural failure due to fatigue especially at pipe nipples, stubs, and instrumentation connections. Fig.1 shows a typical sound spectrum for a compressor we have measured. Various sources at their related frequencies can be depicted and related to a couple of components participating in the noise emission.

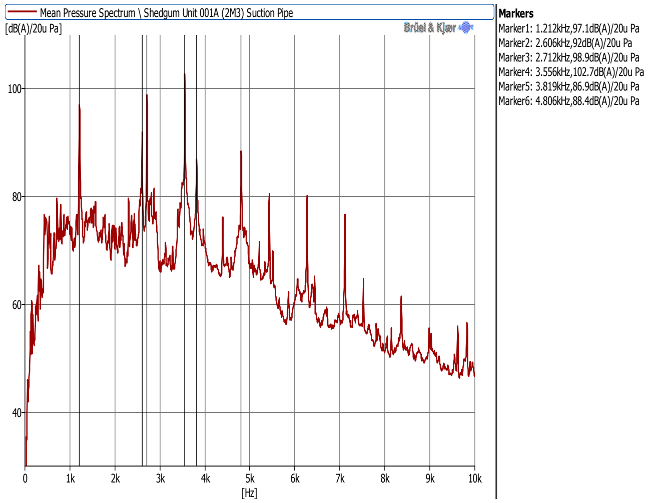


Figure 1: Typical narrow band measured sound pressure level of compressor.

$$f=\frac{c}{2\pi}\sqrt{\frac{F_N}{1.21(V+V_N)\left\{\frac{V}{V+V_N+V_{O1}}-\frac{h}{h+l_N+l_{O1}}\left[l_v+(l_N+l_{O1})\left(1+\frac{1}{2}[\frac{V_N+V_{O1}}{V}+\frac{l_N+l_{O1}}{h}]+\frac{1}{3}\frac{V_N+V_{O1}}{V}-\frac{l_N+l_{O1}}{h}\right)+l_{O2}\right]\right\}}} \quad (1)$$

In any centrifugal compressor as the fluid flow exits the impeller, the flow distribution is distorted. Specifically, such distorted flow is characterized by a low angle (relative to a tangent to the impeller circumference) fluid flow exiting most prominently adjacent to the shroud side of the diffuser. In the past, this distorted flow has been shown to cause severe compressor performance problems [5]. Due to the design of the compressor, the inlet and discharge pipes are relatively more susceptible to noise transmission than the compressor casing itself. Noise propagates through the path with least resistance and since the piping at the inlet has thinner walls when compared to the compressor casing, this provides a path of lower resistance for noise propagation. Between the inlet and the discharge, investigations have found that higher vibration and noise levels emanate from the discharge. Noise generated inside the compressor can propagate upstream to the inlet pipe and downstream to the discharge pipe as the flow is typically subsonic inside compressors. Helmholtz resonators consist of a cavity communicating with the main duct through a neck. They have been widely used to effectively attenuate the narrow band low frequency noise. The classic lumped approach is approximates this resonator as an equivalent spring of cavity and mass (neck) system, and yields the expressions for the resonator frequency and the transmission loss [7]. A previous work by the authors [8] has shown also the design of one and two degrees of freedom resonators to evaluate the effect of the size and arrays on the overall noise attenuation performance.

3 Development of resonator performance

Analytical analysis can be carried out using form factors shown next to include the effect of geometry. We have demonstrated in [8] that numerical computation using COMSOL, analytical and experimental results were in good agreement. A formula for resonant frequencies was developed in the late nineteenth century to include the effect of the geometry of the resonators[11] and is shown in Eq.(1) where, *f*, resonant frequency, *c*, velocity of sound in the gas, F_N, area of the neck, l_N , length of the neck, V_N, volume of the neck ($V_N = F_N \times l_N$), *V*, volume of the resonator without the neck, *h*, height of the resonator from the bottom to the neck (see also the next section), l_v , form factor, defined in Eq.(2).

$$l_v=\frac{F_N}{Vh}\int_0^h\frac{xV(x)}{F(x)}dx \quad (2)$$

here *F*(x) is the area of a cross-section of the resonator expressed as a function of distance x from the bottom and

$$V(x)=\int_0^x F(\xi)d\xi \quad (3)$$

l_{O1}, l_{O2} are two parts of the total end-correction length due to the motion of gas particles outside the resonator. Generally the values $l_{O1} = l_{O2} = 0.24$r, where r is the radius of the neck or opening of the resonator. And V_{O1} is the volume of the hypothetical elongation of the neck due to the motion of gas particles outside the resonator ($V_{O1} = F_N l_{O1}$).

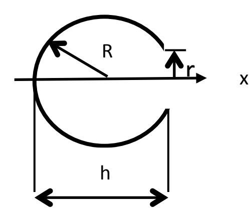
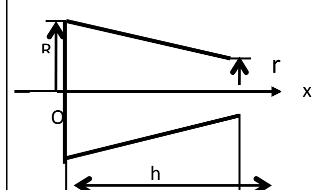
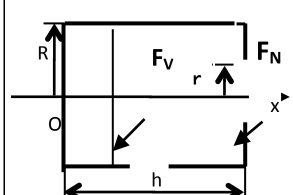
	
Spherical resonator	**Conical resonator**
	
Cylindrical resonator	

Table 2: Resonator shapes considered in this study.

Form factor(l_v) for fundamental forms of volumes [11]

Form factor (l_v) is determined to calculate the effects of forms of volumes of the resonator. Following are the different form factors for volumes.

1. ***Sphere.***

$$l_v = \frac{r^2}{R}\frac{1}{2-A}\left[\frac{1}{3} - \frac{1}{2(A+1)} - \frac{2}{(A+1)^2} + \frac{4}{(A+1)^3}\ln\frac{2}{1-A}\right] \quad (4)$$

where, $A = \sqrt{1-(r/R)^2}$

2. ***Frustum* of a cone.**

$$l_v = \frac{h}{(R/r)^2 + (R/r) + 1}\left[\frac{1}{3} - \frac{R}{2(R-r)} - \left(\frac{R}{R-r}\right)^3\left(\frac{R}{r} - 1 - \ln\frac{R}{r}\right)\right] \quad (5)$$

3. ***Cylinder.***

$$l_v = \frac{F_N h}{3F_V} \quad (6)$$

For an accurate prediction of the resonant frequency in one Degree of Freedom (DOF) cylindrical resonators the following equation (7) can be used [8].

$$\omega = c\sqrt{-\frac{3.L_n + L_c\alpha}{2L_n^{\ 3}} + \sqrt{\left(\frac{3.L_n + L_c\alpha}{2L_n^{\ 3}}\right)^2 + \frac{3\alpha}{L_n^{\ 3}L_c}}} \quad (7)$$

where L_c, L_n, a represent the cavity length, the corrected neck length, and α the ratio of cross sections surface of cavity; a_c and neck; a_n, respectively.

The only restriction in the above mentioned formulae is diameter must be less than a wavelength at the resonance frequency. The transmission loss (TL) for one DOF can also b calculated using the equation [7-10].

$$TL = 10Log_{10}\left[1 + \left(\frac{a_n}{2.a_c}\frac{(1/\alpha)\tan(k.L_c) + \tan(k.L_n)}{(1/\alpha)\tan(k.L_n)\tan(k.L_c) - 1}\right)^2\right] \quad (8)$$

Where k is the wave number. In order to combine the effects of end correction factors the following equations are considered.

$$l_n = L_n - \delta_1 - \delta_2 \quad (9)$$

An en correction that accounts for the higher ordre wave propagation is [12].

$$\delta_2 = 0.48\sqrt{a_n}\left(1 - 1.25\sqrt{\alpha}\right) \quad (10)$$

To account for the higher order wave propagation effects between the circular neck and main pipe (one direction being infinite, while the size of the other direction is close to that of the neck), the end correction is approximated by

$$\delta_1 = 0.46\frac{\sqrt{a_n}}{2} \quad (11)$$

4 Numerical simulations of the various shapes of resonators

COMSOL was used for the FE Analysis. Each cylindrical duct of diameter 10 cm and length 100 cm was fitted with either one or four Helmholtz resonators flush mounted circumferentially at the centre of the duct. The medium of sound propagation was Air. Sound hard boundary wall condition was imposed on all the parts of the duct except inlet boundary and the outlet boundary of the duct where plane wave radiation was considered. The source of sound is a power point source placed at the inlet emitting 5 Watts of (RMS) acoustic power which explains the high level of SPL inside the duct. Same boundary conditions were used for all the four different configurations of the ducts. Tetrahedral elements mesh generating function of COMSOL was used for each duct reaching approximately 1042690 domain elements, 152434 boundary elements, and 10240 edge elements. The size of the elements ranges from 20 mm to 0.2 mm. Since the Frequency range of interest was under 2 KHz, an extremely fine mesh was considered with approximately 7 elements per wavelength which provided a reasonably good estimate of the sound propagation inside the duct.

4.1 Single resonators

A single one DOF cylindrical resonator was simulated numerically. Figure 2 shows an empty pipe without resonator and hence no noise reduction, while if a resonator is added a clear noise reduction is observed. A closer view shows perfectly the resonance inside the resonator inducing noise attenuation along the pipeline immediately after the resonator. The front waves are distorted close to the resonator.

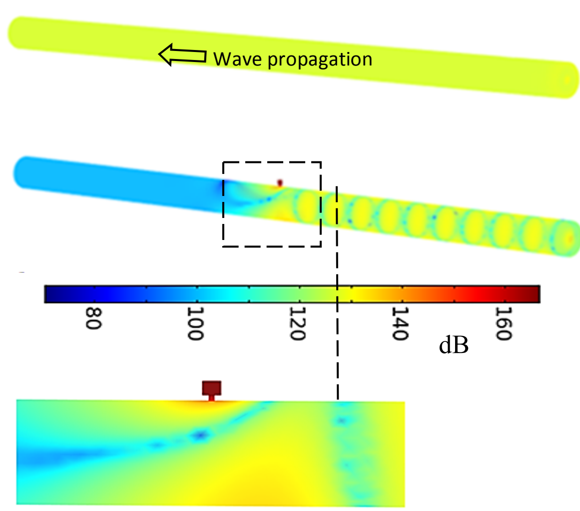


Figure 2: The sound pressure level at 3556 kHz (a) For a pipe without any resonator (b) For a pipe with one 1 DOF cylindrical resonator.

4.2 Array of resonators

Rather than considering one resonator, the pipeline could be loaded with several identical resonators around the pipeline cross section. The resonator distribution is indicated in Fig. 3. The results show an improved noise attenuation compared to the one achieved in Fig. 2 with single attenuation.

In another attempt to investigate the shape effect on the noise reduction, three different shapes of the resonators have been considered. This includes cylindrical, conical and spherical shapes.

The volume of the three cavities was chosen to be equivalent. Numerical simulations have been performed for three various shapes of the resonator. The results shown in Figs 4 to 9 were obtained with three different blade passing frequencies acting at the pipe inlet. The simulations show clear noise reduction for each shape depending on the BPF considered.

Fig.4 shows four resonators mounted in the middle way of the pipe with clear reduction of sound (>40dBA) using spherical resonators compared to other shapes under similar conditions with expected results. Fig 6 and Fig 8 depict the resonance phenomenon in cylindrical and conical resonators respectively. In order to have a clear view of the sound pressure level distribution in the pipes Figs 5, 7 and 9 can be referred to for spherical, cylindrical and conical geometries respectively. A simulation was carried out to compare the effect of resonators array on the transmission loss achieved.

Figs. 2 and 6 where two different pipes with a single and an array of four one DOF cylindrical resonators were simulated and compared. It was found that increasing the number has a very limited effect range, increasing the transmission loss by around 5 dB.

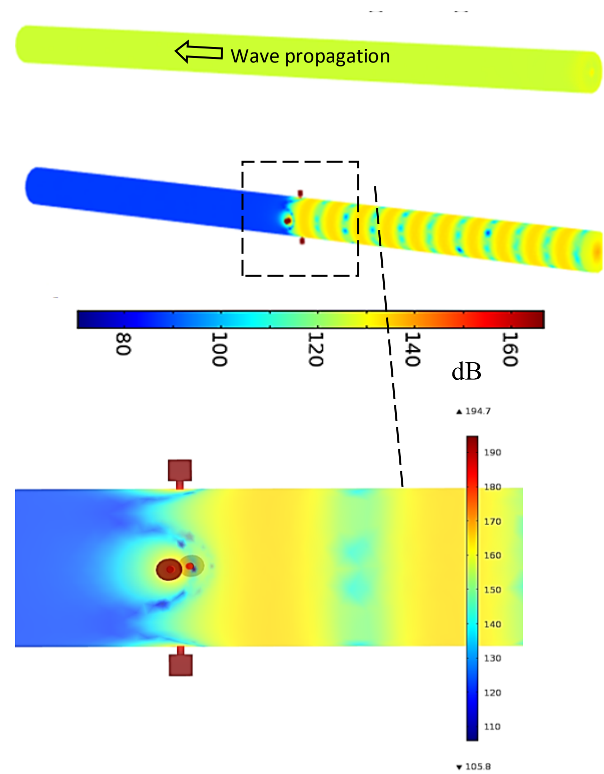


Figure 3: Sound Pressure levels distribution at 3556 Hz on the surface of the pipe with and without 1 DOF designed array resonators with a closer view of the tuned resonators.

When comparing the results for the two configurations of arrays, i.e. one and four sets of resonators, the frequency for which they are designed doesn't match accurately showing a little difference of around 30-50 Hz. This happens because when array of resonators are put around their resonating frequencies some of them resonate for a particular value while others could not achieve full resonance for that value and this happens due to possibly incomplete air flow filling in the resonators at the same time due to neck size and/or numerical slight precision in positioning different orientations of the resonators on the duct. This phenomenon can be perceived from Fig.9, where different SPL are encountered for a particular designed frequency in the conical resonators, and also in Fig.10 that exhibits sound pressure levels of several configurations treated numerically. Four resonators show better attenuation of sound level compared to single resonator as expected. The numerical results exhibit a frequency shift due possibly to the array of resonators total volume and size affecting the natural frequency in Eq. (1) and Eq. (6).

Another notable observed feature is for one resonator the reduction of noise takes a while which is clear from Fig. 2, while in the case of four resonators the reduction is almost instant as in Fig. 7.

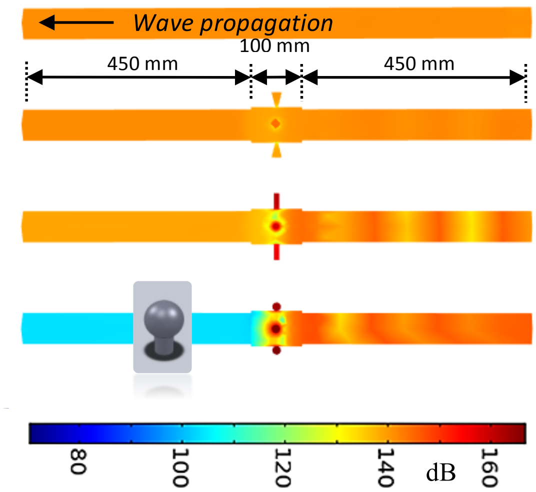


Figure 4: The sound pressure level at 1.284 kHz (a) Pipe without any resonators, (b) Pipe with conical resonators,(c) Pipe with cylindrical resonators, (d) Pipe with Spherical resonators(Spherical resonant frequency).

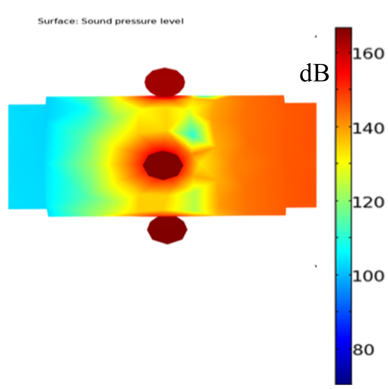


Figure 5: A closer view of the sound pressure level distribution at 1.284 kHz (Spherical resonant frequency).

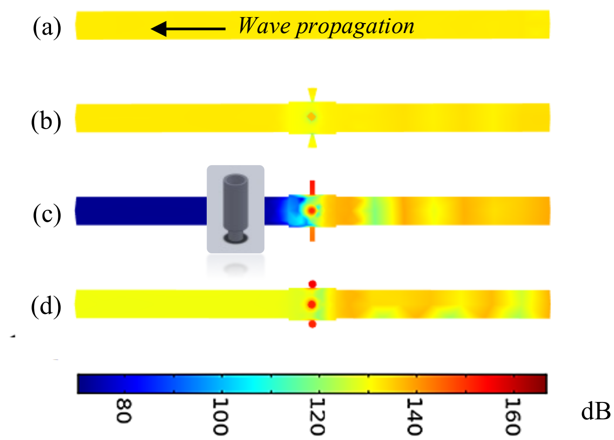


Figure 6: The sound pressure level at 1.15 kHz (a) Pipe without any resonators, (b) Pipe with conical resonators(c) Pipe with cylindrical resonators (Cylindrical resonant frequency), (d) Pipe with Spherical resonators.

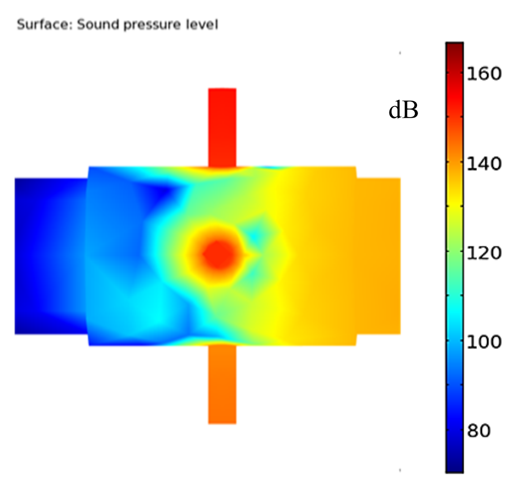


Figure 7: A closer view of the sound pressure level distribution at 1.15 kHz (Cylindrical resonant frequency).

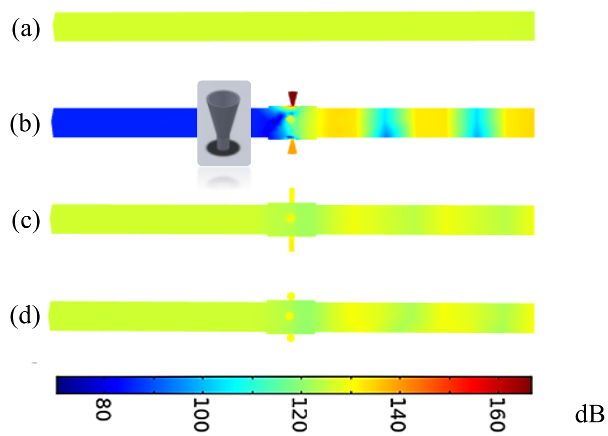


Figure 8: The sound pressure level distribution at 0.84 kHz (a) Pipe without any resonators (b) Pipe with conical resonators (Conical resonant frequency) (c) Pipe with cylindrical resonators (d) Pipe with Spherical resonators.

Fig. 11 represents a numerical comparison of the sound pressure levels of the three different geometries simulated. On careful consideration the resonant frequencies found for cylindrical and conical resonators from the experiments match closely with the frequencies found in the simulations.

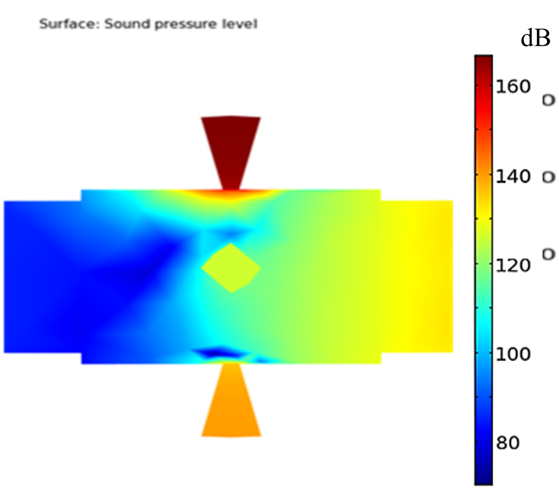


Figure 9: A closer view of the sound pressure level distribution at 0.84 kHz (Conical resonant frequency).

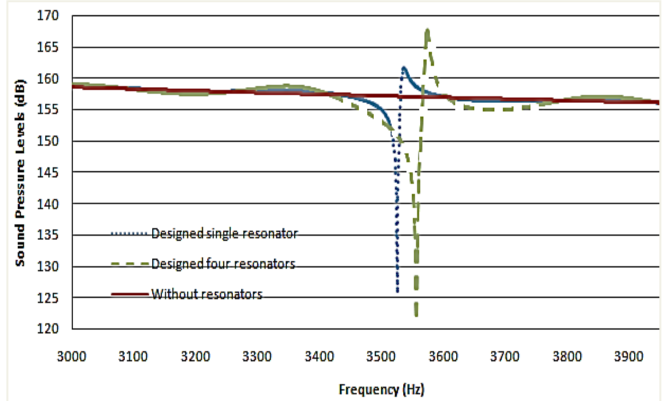


Figure10: Comparison of Transmission Loss with respect to frequency for one and four sets of one DOF cylindrical resonator.

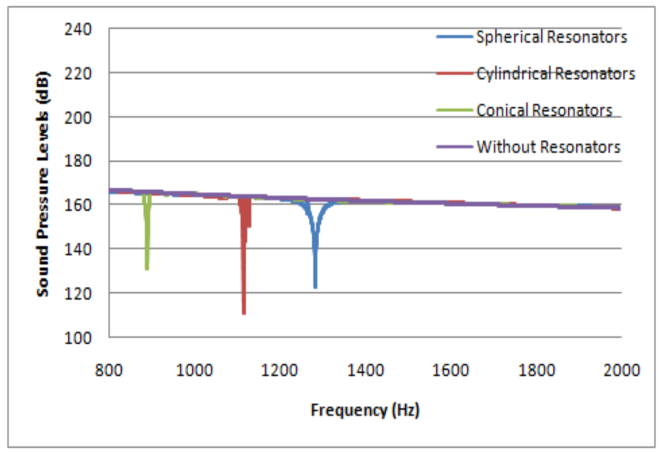


Figure 11: A comparison of the sound pressure levels from the simulations for a pipe fitted with three different arrays of resonators with a pipe without any resonator.

Fig. 11 shows the resonator response over their effective ranges. An anti-resonance behavior was displayed at around 1200 Hz in cylindrical resonator arrangement and at around 930 in conical resonator arrangement which caused the noise level to amplify by around 3dB. This phenomenon is not uncommon in such resonator arrangements.

5 Experimental results and validation

A one meter straight PVC pipe was cut into two equal parts of 450 mm. Using rapid prototyping process three different geometries of the resonators were manufactured and were fitted on another manufactured polymeric pipe of 100 mm containing holes as shown in Figs. 13 a) to c). A preliminary test was made using the one meter PVC pipe with no resonators to check the effect of natural damping due to the air itself. The pipe was attached to the insulation and mounted on a stand while the generated noise level was varied between 800 to 2000 Hz on one side of the pipe and similar level was collected on the other end, implying that there was little to no damping within the pipe. Finally the duct tape was added as a precaution to hold it in place. Fig. 12 shows a picture of the experimental set up used for the test. The aim was to find the range over which the resonators are effective along with the resonant frequency of the resonator and gives maximum noise attenuation. Initially the starting frequency was set at 800 Hz.

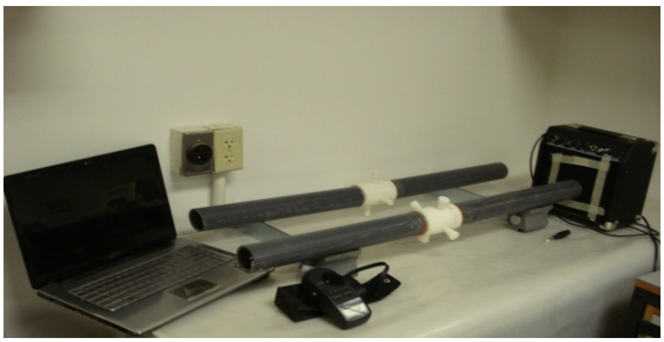


Figure 12: A picture of the experimental setup established to measure the noise attenuation offered by the modeled resonators.

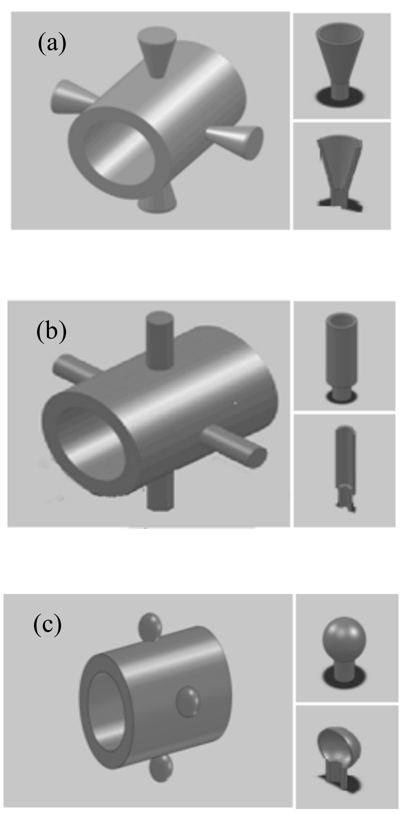


Figure 13: Various resonators Arrangement (a) Conical, (b) Cylindrical, (c) Spherical.

The noise source was a speaker generating a sine wave with maximum SPL of 121 dB was verified and then the pipe was attached to the noise source. A check was made along the pipe using the sound meter to identify any acoustic leakage. To verify any acoustic leakage, a noise measurement at the outlet was taken. A noise decrease of 2 dB was observed. Then the process was continued varying the frequency systematically, first increasing at regular intervals and then decreasing, whilst recording the sound level until the noise levels of the source were reached, and consequently no attenuation was found. This has established a range of values around which the resonator provided some level of attenuation. Through varying the frequency it was found that the resonant frequency of the conical arrangement was nearly 840 Hz at which a reduction of around 8 dB was observed. The noise level was found to be 106 dB. There was another check made using the noise level meter against acoustic leakages along the pipe and verify the source noise levels, and it was found that such leakages were completely negligible. Next was the testing of the cylindrical pipe arrangement. A similar sweep was performed using the sound meter to check for leakages and it was found that there were minor leakages around the connection region that might tamper with the experimental results. A sleeve made of cotton cloth was made to blanket the noise levels at these locations. The points of leakage were checked and it was found that the cotton cloth successfully blocked any acoustic leakage. On repeating the test for cylindrical resonators the resonant frequency was found to be approximately 115 dB. The spherical case couldn't be tested since the spherical resonators had pores due to some defects in the rapid prototyping process during their manufacturing.

In the numerical investigation the spherical resonators are also found to have the same behavior as predicted from the analytical results. The noise reduction achieved in the experiments are less than those achieved in the COMSOL simulations which could be due to following reasons: One dimensional propagation is assumed in the simulations which can be attenuated more easily than the actual three dimensional propagation in the experiments, improper acoustics terminations at the open ends, damping offered by the polymeric material and the PVS pipe due their acoustic absorption coefficients. A slight shift in the natural frequency may be due to the fact that the volume was not anymore equivalent due to rapid prototyping inaccuracy of the cavities.

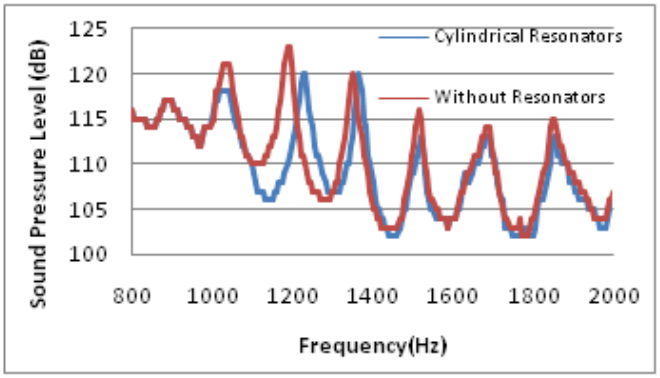


Figure 14: A comparison of the sound pressure levels from the experiments for a pipe fitted with an array of cylindrical resonators with a pipe without any resonator.

6 Conclusion

A numerical simulation validated by analytical method and experimental tests to estimate the level of noise attenuated using Helmholtz resonators as an add-on solution to pipeline has been presented in this paper. The method was used to analyze the effects of the various shapes e.g. cylindrical, conical, and spherical on the noise reduction in pipelines. The effect of number of resonators has also been studied and presented.

Comparison tests between various shapes of the resonator have shown in both numerical and experimental methods that cylindrical resonators give better noise attenuation than the conical and the spherical resonators. The three different geometries have distinct resonant frequencies and transmission loss even though the volume for all the cases is equal (Figs 11 and 14). Some of the noted effects of number of resonators are when using one resonator the reduction of noise takes a while, but in the case of four resonators the reduction is almost instant. Also the increase in transmission loss achieved by increasing the number of resonators from one to four has a very limited effect range, increasing the transmission loss by around 5 dB.

Further investigations will be considered based on these findings to refine the parametric design and investigate the effect of size for example. Different sizes of sound absorbing materials can also be experimented and there by checked for the noise attenuation for comparison purposes. It is recommended that the analytical equations for the different geometries have a considerable room for improvement in accuracy and should be given due consideration even though their manufacturability is a tough task.

Acknowledgments

The authors would like to acknowledge the support provided by the research collaboration between King Fahd University of Petroleum& Minerals (KFUPM) and Dresser-Rand Company (USA).

References

[1] Zheji Liu and Mark J. Kuzdzal ,*Noise Control Of An 11,000 Horsepower Single Stage Pipeline Centrifugal Compressor*, Proceedings of ASME Turbo Expo 2007 Power for Land, Sea, and Air, May 11, 2007

[2] Zheji Liu and Mark J. Kuzdzal , *Noise Reduction Of A Multistage Export / Reinjection Centrifugal Compressor Through The Use Of Duct Resonator Arrays*, Dresser-Rand Company Olean USA , 2002

[3] Till Raitor, Wolfgang Neise, *Sound generation in centrifugal compressors*, Journal of Sound and Vibration, Volume 314, Issues 3-5, 22 July 2008, Pages 738-756

[4] It All Boils Down To Two Things www.wgs4.com.

[5] W. Neise, G.H. Koopmann, *Reduction of centrifugal fan noise by use of resonators*, Journal of Sound and Vibration, Volume 73, Issue 2, 22 November 1980, Pages 297-308

[6] Kim Jeung, Imam Imdad. "*Compressor Noise Attenuation Using Branch Type Resonator*". Patent 4,927,342. May 22, 1990.

[7] Mekid S. and Farooqui, M. Design of Helmholtz resonators in one and two degrees of freedom for noise attenuation in pipelines, Acoustics Australia, Vol. 40 No 3, 2012.

[8] Munjal MI, Acoustics of ducts and mufflers with application to exhaust and ventilation system design, New York Wiley, 1987.

[9] Selamet A, Radavich PM, Dickey NS, Novak JM.*Circular concentric Helmholtz resonators*. JAcoSoc Am 1997, 101:41–51.

[10] Li, D. (2003). *Vibroacousticbehaviour and noise control studies of advanced composite structures*. PhD thesis, University of Pittsburgh.

[11] M.Alster. *Improved calculation of resonant frequencies of Helmholtz resonators* Journal of sound and vibration 1972, 24(1) 63-85.

[12] Selamet A, Lee I-J. *Helmholtz resonator with extended neck*. J AcoustSoc Am2003; 113:1975–85.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COMMENTS ON "*VALIDATION OF THE CSAZ107.56 STANDARD METHOD FOR THE MEASUREMENT OF NOISE EXPOSURE FROM HEADSETS*" BY G. NESPOLI, A. BEHAR & F. RUSSO, VOL. 41, NO. 3 (2013)

Christian Giguère
School of Rehabilitation Sciences, U. of Ottawa, 451 Smyth Rd., Ontario, Canada, K1H 8M5

The authors present a study aimed at validating the method described in CAN/CSA Z107.56-13 to estimate the sound exposure arising from the use of communication headsets in the workplace. The data was reported in a different way than specified in the Standard, which led to inappropriate comparisons that inhibit proper interpretation of the study.

The estimation method in Clause 7.3.4 of CAN/CSA Z107.56-13 is based on the principle that, in a practical situation, the user will likely adjust the volume of the audio channel of the headset, and thereby the listening signal-to-noise ratio (SNR), so as to ensure proper reception of speech given the masking effect of the background noise. The Standard specifies an A-weighted effective listening SNR of 15 dB to be used to estimate the sound exposure of a worker wearing headsets, given the A-weighted external background noise (L_N) and noise reduction of the headset (*NR*). Assuming that the audio signal is always present when the headset is fitted, consistent with the study by Nespoli et al. (2013), the sound level is calculated as:

$$L_{headset} = 10\log\left(10^{(L_N - NR)/10} + 10^{(L_N - NR + SNR)/10}\right) \qquad 1)$$

The first term is the exposure to the background noise attenuated by the headset shell, and the second term is the exposure to the audio channel.

In their paper, Nespoli et al. (2013) are using an artificial ear method, specified in Clause 7.3.3.3 of the Standard, to test the estimation method with a group of laboratory subjects for different background noises and headsets. According to the paper, "*the parameter investigated … was the noise exposure increase in the headset due to the speech signal*". The noise exposure increase was calculated as the difference in sound level between (1) the combined speech signal plus residual noise through the headset measured with the device fitted on the artificial ear, and (2) the background noise in the artificial ear without the device fitted. In other words, and as best as can be inferred from the paper, the data reported by the authors is the increase in exposure as a result of wearing a headset in background noise with respect to the open-ear exposure in the same background noise. Thus, the data reported correspond to $L_{headset}-L_N$ in equation (1).

The "exposure increase" metric used by Nespoli et al. (2013) can be useful to draw certain conclusions about the impact of introducing communication headsets in an environment where workers are otherwise working in open ears (e.g. in demonstrating that headsets with higher sound attenuation reduce overall exposure). However, as is clearly apparent from equation (1), $L_{headset} - L_N$ is far different from and does not equate to the "effective listening SNR" specified in the Standard, and this invalidates any direct comparison between the two metrics (e.g. in declaring the exposure increase to be very different than the 15 dB specified in the Standard).

The difference between the two metrics, exposure increase $L_{headset} - L_N$ and effective listening SNR, is easily illustrated using the data reported by Nespoli et al. (2013). They measured an A-weighted noise reduction of about 23 dB in construction noise with their high attenuation headset. Assuming a construction noise of 80 dBA, the estimated sound level from equation (1), with a SNR of 15 dB, is $L_{headset}$ = 72.1 dBA, which corresponds to an estimated exposure increase $L_{headset} - L_N$ of -7.9 dB. Using the noise reduction in construction noise measured for their low attenuation headset, *NR* = 6 dB, the estimated exposure increase $L_{headset} - L_N$ becomes +9.1 dB. In other words, the same SNR of 15 dB leads to different estimated exposure increases depending on the noise reduction of the headsets. It is therefore not surprising that the authors found their exposure increase data to be "*drastically different from the 15 dBA stipulated in the Standard*" and stated "*it also seems that the 15 dB value is too high*". The two metrics cannot be compared in the way presented by the authors. To provide insight into the method proposed in the Standard, Nespoli et al. (2013) had to compare their "measured" exposure increase to the "estimated" increase $L_{headset}-L_N$ arising from equation (1), and not to the SNR of 15 dB per se.

There are further complications in making a direct comparison as described above for the current data set as a result of certain methodological choices made by the authors. Firstly, the authors report $L_{headset}$ and L_N data measured in the artificial ear, whereas these parameters are sound field equivalent levels in the Standard. Thus, their measurements must be transformed back to the sound field using third-octave band procedures prescribed in the Standard. This step is needed because the transformation between artificial ear and sound field equivalent levels is frequency-dependent, and typically will be different for $L_{headset}$ (speech dominated) and L_N (noise). Secondly, an accurate estimate of the sound attenuation of the headsets is needed to calculate the expected exposure increase using equation (1). The authors used the artificial ear to measure attenuation, but such a test fixture is not qualified for attenuation measurements. The primary difficulty lies in the lack of sufficient sound isolation in artificial ears, particularly at low frequencies, which can lead to an underestimation of attenuation. Thirdly, the authors used background noise levels as low as 60 dBA and, when combined to the high attenuation headset, the question arises as to whether the subjects were adjusting the headset volume based on the masking effect of the residual noise, as assumed in the Standard, or on some other audibility criterion more related to speech listening in quiet. It also seems odd that the authors could not produce distortion free background noise levels above 70 dBA using an array of five loudspeakers.

Finally, a laboratory study cannot be construed as validating a method, as implied by the title of the paper, which was calibrated on the basis of field data. The 15 dB number specified in the Standard was based on a meta-analysis of field studies comprising a total of 55 measurement cases covering intra-aural, supra-aural and circumaural communication headsets with real workers in a range of civil and military noise environments (Giguère et al., 2012). The reported mean A-weighted listening SNR was 13.7 dB with a standard deviation of 5.9 dB, indicating that in 68% of cases the listening SNR in the field ranged from 7.8 to 19.6 dB. The field data, based on measurements with real workers, include all associated aural and non-aural tasks required by the job and provide the highest level of face validity. Laboratory data, with test subjects at rest focusing on the experiment, can easily underestimate the headset signal level used in the field. Hodgetts et al. (2007), for example, reported a 3 dB increase in the preferred volume levels in noise when users of portable music devices are exercising as opposed to being at rest.

In summary, Nespoli et al. (2013) report laboratory data on the effect of different background noises on the exposure increase arising from the use of communication headsets with respect to the open-ear exposure in the same background noises. This metric is far different from the effective listening SNR parameter specified in CAN/CSA Z107.56-13. A comparison with the Standard requires a complete re-analysis of the data and consideration of the difference between laboratory and field validation.

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The author wishes to thank Hilmi R. Dajani (University of Ottawa) and Stephen E. Keith (Health Canada) for their valuable comments.

REFERENCES

CAN/CSA Z107.56-13. “Measurement of Noise Exposure,” Canadian Standard CAN/CSA Z107.56-13, Canadian Standards Association, Mississauga.

Giguère, C. , Behar, A., Dajani, H.R., Kelsall, T., and Keith, S.E. (2012). “Direct and indirect methods for the measurement of occupational sound exposure form communication headsets,” Noise Control Engr. J., 60(6), 630-644.

Nespoli, G.N., Behar, A., and Russo, F. (2013). “Validation of the CSAZ107.56 Standard Method for the Measurement of Noise Exposure from Headsets,” Canadian Acoustics, 41(3), 31-36.

Hodgetts, W.E., Rieger, J.M., and Szarko, R.A. (2007). “The effects of listening environment and earphone style on preferred listening levels of normal hearing adults using an MP3 player”, Ear Hear., 28(3), 290–297.


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Response to Comments on "*Validation of the CSAZ107.56 Standard Method for the Measurement of Noise Exposure from Headsets*" Vol. 41, No. 3 (2013)

Gabe Nespoli, Alberto Behar, & Frank A. Russo
Department of Psychology, Ryerson University, 105 Bond St, Toronto, Ontario, Canada, M5B 1Y3

We wish to report an error in Figure 4 of our paper entitled "Validation of the CSA Z107.56 Standard Method for the Measurement of Noise Exposure from Headsets", published in Volume 41 of Canadian Acoustics (Nespoli, Behar, & Russo, 2013). The figure caption states that the plotted values represent sound level increases attributable to speech, or the "effective listening SNR" as indicated in the CSA Standard. However, the values that are plotted represent the difference between the sound level under the cup of the headset and the sound level of the background noise, or $L_{headset} - L_N$. The revised figure displayed here is consistent with the original caption.

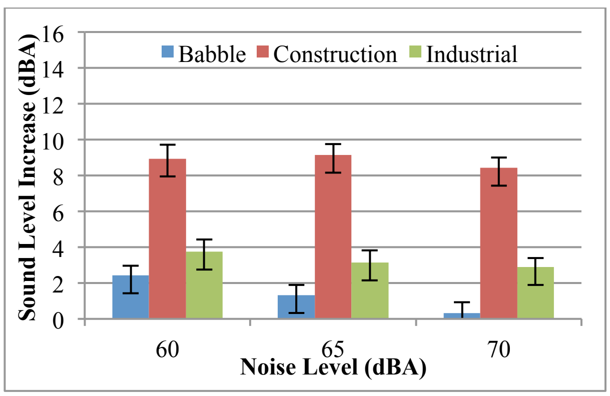

Figure 4a-revised. Increase of sound level due to speech for the low-attenuation headset.

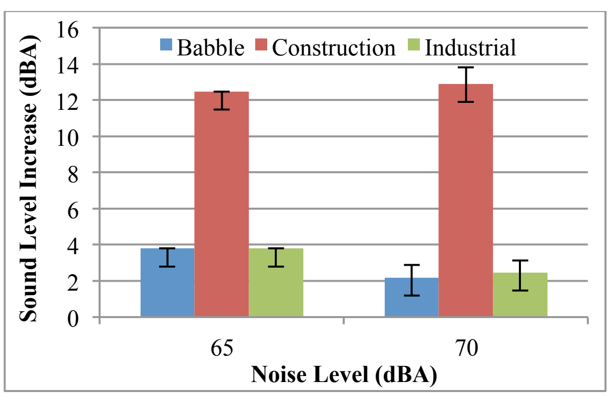

Figure 4b-revised. Increase of sound level due to speech for the high-attenuation headset.

In light of the response to our paper by C. Giguère, it also seems prudent to clarify some additional aspects of the study. First, our experimental configuration involved only two loudspeakers (see Figure 1 from the original paper), which limited the level of distortion-free sound that we were able to obtain in the lab. Second, our primary intention was to investigate the effects of different background noises and headsets on noise exposure, particularly as it pertains to the estimation method in Clause 7.3.4 of the Standard. To reiterate, the method in the Standard ascribes a single value (15 dBA) for the effective listening SNR, regardless of type of background noise or headset. This value was derived empirically on the basis of a meta-analysis of field studies (Giguère et al., 2012).

We observed a wide range of of SNRs for the different types of background noises and headsets tested, which led us to suggest caution in the use of the estimation method. Although the average increase we observed for construction noise (10.39 dB) fell within the range reported in the meta-analysis (13.7 dB ± 5.9 dB) that was conducted by Giguère et al. (2012), the babble and industrial noises fell below this range (2.01 dB and 3.21 dB, respectively). It is notable that the industrial noise sample possesses more high-frequency energy between and 1 and 4 KHz than the other two background noises (see Figure 3 from the original paper). Considering the importance of this frequency region for speech intelligibility (ANSI S3.5, 1997; Warren, Bashford, & Lenz, 2005), we would therefore expect that construction noise would lead to higher SNRs than babble and industrial noises.

The other contribution of our study that we wish to highlight is the effect of the type of headset. In particular, the high-attenuation headset led to larger exposure increases due to speech. This is an expected finding if we assume that listeners possess some internal criterion for total tolerable sound level. In other words, the effective listening SNR appears to be moderated by the overall level of sound exposure. Specifically, the effective listening SNR is smaller when the background noise is louder.

We acknowledge that the absolute values obtained in our study were consistently lower than the average determined by Giguère et al.'s (2012) meta-analysis upon which the estimation method is based. There are numerous potential reasons for this discrepancy that have already been described in Giguère's letter ranging from (a) our artificial ear method, (b) the relatively low level of background noise, and (c) the artificiality of the lab-based testing environment. Nonetheless, the differences we observed across background noises and headsets remain, and are interpretable. These differences lead us to recommend caution in the application of a single value to estimate the effective listening SNR for workers wearing headsets.

REFERENCES

American National Standard Methods for Calculation of the Speech Intelligibility Index. New York: American National Standards Institute; 1997.

CAN/CSA Z107.56-13. "Measurement of Noise Exposure," Canadian Standard CAN/CSA Z107.56-13, Canadian Standards Association, Mississauga.

Giguère, C., Behar, A., Dajani, H. R., Kelsall, T., & Keith, S. E. (2012). Direct and indirect methods for the measurement of occupational sound exposure from communication headsets. *Noise Control Engineering Journal, 60(6),* 630–644.ANSI S3.5.

Nespoli, G., Behar, A., & Russo, F. A. (2013). Validation of the CSA Z107.56 standard method for the measurement of noise exposure from headsets. *Canadian Acoustics, 41*, 31–36.

Yearly Reviewer List / Liste annuelle des évaluateurs

The high scientific standards maintained by Canadian Acoustics in its papers owe much to the continuing dedication of the journal's reviewers, who give freely of their time and expertise. JCAA is pleased to pay tribute to this contribution by recognizing those who have participated in the review process. Thus, the Editorial Team of Canadian Acoustics acknowledge with particular gratitude the following reviewers who have reviewed papers during the period June 2013 – MAy 2014.

Les normes scientifiques élevées maintenues par la revue Acoustique canadienne doivent beaucoup au dévouement constant des réviseurs de la revue, qui donnent généreusement de leur temps et de leur expertise. JCAA est heureux de rendre hommage à cette contribution en reconnaissant ceux qui ont participé au processus d'examen. Ainsi, l'équipe de rédaction de l'Acoustique Canadienne reconnaît avec une gratitude particulière les réviseurs suivants qui ont examiné des articles au cours de la période de juin 2013 - mai 2014.

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Come To Winnipeg
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ACOUSTICS WEEK IN CANADA

October 8-10, 2014

Canadian Museum For Human Rights, and the Riel Esplanade, with downtown Winnipeg beyond.
Photo by Dan Harper, Courtesy of Tourism Winnipeg

For the first time, Acoustics Week In Canada will be held in Winnipeg, Manitoba. This central location should make it easy for participants from all areas of the country to come together for 3 days of plenary lectures and technical sessions, along with the acoustical standards committee meeting, the exhibition of acoustical equipment and services, the Canadian Acoustical Association Annual General Meeting, the conference banquet and other special events. The conference will be held in the heart of Winnipeg, just off the famous corner of Portage and Main, surrounded by restaurants, theatres, and within easy walking distance of the spectacular new Canadian Museum of Human Rights, and The Forks recreation area, featuring more great shopping, restaurants, and activities. Conference participants can be among the first in Canada to view the new Canadian Museum Of Human Rights, which is scheduled to officially open in September 2014.

Venue & Accommodation – The conference will be held at **The Fairmont**, Winnipeg's premiere hotel. It features recently re-furbished comfortable rooms, and an excellent exercise facility, including a large salt-water pool, steam room, and luxury spa, all with excellent city views (http://www.fairmont.com/winnipeg/). The Velvet Glove restaurant is routinely rated as one of Canada's finest, and features inspired Manitoba sourced cuisine, and a unique wine list. A block of rooms is available until September 8, 2014 at the special rate of $149.00 per night, and a limited number of rooms will be available for students at $119.00. **Call 1-800-257-7744 to reserve your room before the deadline, and please be sure to specify that you are with the "Canadian Acoustical Association".**

Assiniboine River Walk
Photo by Ruehle Design, Courtesy Tourism Winnipeg

The Fork
Photo by Dan Harper, Courtesy Tourism Winnipeg

Plenary Lectures/Technical Sessions – There will be several plenary lectures slated covering current acoustical topics, and highlighting regional expertise and situations. Technical sessions will cover all major areas of acoustic interest, including Hearing Loss Prevention, Acoustical Standards, Architectural Acoustics, Noise Control, Shock and Vibration, Hearing and Speech Sciences, Musical Acoustics, Underwater Acoustics and other topics. **If you would like to propose and/or organize a special session on a specific topic please contact the Technical Chair as soon as possible.**

Exhibition & Sponsorship – There will be an exhibition area for acoustical equipment, products, and services on Thursday October 9. If you or your company is interested in exhibiting, or if you would be interested in sponsoring a conference social event, technical session, coffee breaks, or student prizes, please contact the Exhibition Coordinator. The conference offers an excellent opportunity to showcase your company and products or services.

Student Participation – Students are enthusiastically encouraged to attend the conference. Travel subsidies and reduced registration fees will be available, along with the special $119.00 hotel rate. Student presenters are eligible to win prizes for best presentations.

Paper Submissions – The abstract deadline is June 15, 2014. Two-page summaries for publication in the proceedings of Canadian Acoustics are due by August 1, 2014. Please see further details on the conference website.

Registration – Details will be available shortly at the conference website. Early registration at a reduced fee is available until September 8, 2014.

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Canadian Museum for Human Rights
Photo par Josel Catindoy, courtoisie de Tourism Winnipeg

Pour la toute première fois, la Semaine canadienne d'acoustique se tiendra à Winnipeg au Manitoba. Cette destination centrale facilitera la venue des participants de tous les coins du pays pour 3 jours de séances plénières et sessions scientifiques, ainsi que la rencontre du comité des normes en acoustique, l'exposition d'équipement et de services en acoustique, l'assemblée générale annuelle de l'Association canadienne d'acoustique, le banquet du congrès et autres événements spéciaux. Le congrès aura lieu au cœur même de Winnipeg tout près de la célèbre intersection Portage et Main, entourée de restaurants et théâtres, à une courte distance à pied du spectaculaire nouveau « Musée canadien des droits de l'homme » et du quartier « The Forks » avec plusieurs grands magasins, restaurants et une foule d'activités. Les participants au congrès seront parmi les premiers au Canada à voir le tout nouveau Musée canadien des droits de l'homme dont l'ouverture officielle est prévue pour septembre 2014.

Lieu du Congrès et Hébergement – Le congrès se tiendra à l'hôtel **Fairmont**, le meilleur hôtel de Winnipeg. Il dispose de chambres confortables récemment rénovées et d'un excellent centre de mise en forme, y compris une grande piscine d'eau salée, un sauna et un spa de luxe, le tout avec une vue imprenable sur la ville (http://www.fairmont.com/winnipeg/). Le restaurant Velvet Glove est régulièrement coté l'un des meilleurs au Canada et offre des plats inspirés de la cuisine du Manitoba et une carte de vins unique. Un bloc de chambres est offert au taux préférentiel de $149,00 par nuit avant le 8 septembre 2014. Un nombre limité de chambres seront disponibles pour les étudiants au taux de

$119,00. **Veuillez composer le 1-800-257-7744 pour réserver votre chambre avant la date limite. Il est important préciser que vous êtes avec l 'Association canadienne d'acoustique.**

Centre de mise en forme, Photos courtoisie de l’hôtel Fairmont Winnipeg

Séances plénières et sessions scientifiques – Plusieurs présentations plénières dans des domaines d’intérêt en acoustique sont prévues, mettant en évidence l'expertise et le cadre régional. Des sessions scientifiques seront organisées dans tous les domaines principaux de l’acoustique, incluant la prévention de la perte auditive, la normalisation, l’acoustique architecturale, le contrôle du bruit, les chocs et vibrations, les sciences de la parole et de l’audition, l’acoustique musicale, l’acoustique sous-marine et autres sujets. Si vous désirez suggérer ou organiser une session spéciale, veuillez communiquer avec le directeur scientifique le plus tôt possible.

Exposition technique et Commandite – Il y aura une exposition d’équipement, produits et services en acoustique le jeudi 9 octobre. Si vous ou votre entreprise êtes intéressés à réserver une table d’exposant ou commanditer des événements sociaux, des sessions scientifiques, des pauses café, ou des prix étudiants, veuillez communiquer avec le coordinateur de l’exposition technique. La conférence offre une excellente occasion de promouvoir votre compagnie, vos produits, ou vos services.

Participation étudiante – La participation étudiante est fortement encouragée. Des subventions de voyages et des frais d’inscription réduits seront offerts en plus d’un taux spécial de $119.00 pour la chambre d’hôtel. Des prix seront décernés pour les meilleures présentations étudiantes.

Soumissions de communications – La date d’échéance pour la soumission des résumés de présentation est le 15 juin 2014. Les articles de deux pages pour publication dans le numéro spécial des actes de congrès dans l’*Acoustique canadienne* sont dus le 1 août 2014. Plus de renseignements suivront sur le site internet du congrès.

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New and Unified Templates for Canadian Acoustics Articles

Cécile Le Cocq *[1], **Jérémie Voix** †[2], **and Lucius Munatius Plancus** ‡[2]
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Abstract

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Keywords: clarity, ease-of-use, performance, professionalism

Résumé

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Mots clefs: clarté, simplicité, performance, professionnalisme

1 Introduction

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4 Discussion

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5 Conclusions

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References

[1] Edward Witten. Duality in string theory gives rise to quantum gravity.

[2] A. Einstein, B. Podolsky, and N. Rosen. A conjecture to end all. *Phys. Rev.*, 47 :777, 1935.

[3] R. P. Feynman. Positrons are electrons traveling backwards in time. *Phys. Rev.*, 94 :262, 1954.


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NOUVEAU GABARIT UNIFIÉ DES ARTICLES POUR LA REVUE ACOUSTIQUE CANADIENNE

Cécile Le Cocq *[1], **Jérémie Voix** †[2] **et Lucius Munatius Plancus** ‡[2]
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Résumé

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Mots clefs: clarté, simplicité, performance, professionnalisme

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1 Introduction

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2 Méthode

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4 Discussion

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5 Conclusions

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Références

[1] Edward Witten. Duality in string theory gives rise to quantum gravity.

[2] A. Einstein, B. Podolsky, and N. Rosen. A conjecture to end all. *Phys. Rev.*, 47 :777, 1935.

[3] R. P. Feynman. Positrons are electrons traveling backwards in time. *Phys. Rev.*, 94 :262, 1954.

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