

Chronicle

Preventing Noise and Vibration During the 60 Years of Activity of the Central Institute for Labour Protection – National Research Institute

Wiktor Marek ZAWIESKA, Dariusz PLEBAN

Central Institute for Labour Protection
– *National Research Institute*
Czerniakowska 16, 00-701 Warszawa, Poland
e-mail: {mazaw, daple}@ciop.pl

1. Introduction

In 2010, the Central Institute for Labour Protection – National Research Institute celebrated the 60th anniversary of its activity. Primary objectives of the Institute have been and continue to be the protection of employees against any hazards at work stations. Among the numerous hazards, vibroacoustic ones are becoming prevailing. Therefore, one can now dare to say that the 60 years of activity of the Central Institute for Labour Protection have also meant 60 years of preventing noise and vibration in the working environment. For those 60 years of activity, Central Institute for Labour Protection has been associated with outstanding acousticians and vibration specialists. The first chairperson of the Scientific Council of the Central Institute for Labour Protection was Professor Ignacy Malecki, one of the most outstanding Polish scientists. Chairpersons of the Council have also included Professor Adam Lipowczan and Professor Zbigniew Engel and the members of the Council have included Professor Stefan Ziemba and Professor Jerzy Sadowski.

In 1956, the Institute established the Department of Vibration Research, further transformed into the Department of Technical Acoustics and since 1990 – the Department of Acoustic and Electromagnetic Hazards. The Department was founded and for a long time headed by Assistant Professor Czesław Puzyna. Following Professor Puzyna's retirement, the Department was headed by Assistant Professor Danuta Augustyńska. At present, it is the Department of Vibroacoustic Hazards, since 2007 headed by Dariusz Pleban, Ph.D., Eng.

2. First years of activity

The main directions of the activity conducted by the Department since its establishment have been related to: recognition of the level of hazard arising from noise and vibrations in the working environment, development and improvement of methods of measurement and assessment of noise and vibration, research into the impact of noise and vibration on human organism, development of technical and organisational solutions with respect to reducing noise and vibration at the source of them (including machinery and equipment) as well as during propagation, development and examination of hearing protection and enclosures intended to damp vibration.

The first scientific and technical works conducted at the Institute regarded research into methods of measurement and evaluation criteria of noise and vibrations in the working environment that were pioneering in Poland. Further works regarded identification of noise and vibration hazards in different fields of industry and economy. There were also conducted works regarding the impact of noise and vibrations on the human organism.

As a result of the works executed there were developed, among others, methods of noise measurement at work stations and methods of noise source examination (machinery). The results of those works were allowed for in the Polish standards, successively amended pursuant to international standards, and enabled the scientists to, among other things, develop and build a reverberation room and an anechoic chamber at the Institute – those being one of the first in the country.



Fig. 1. The team of Acoustic Department at the test ultrasonic cleaner in the reverberation room. From the left: J. Okrański, B. Miszczyk, Cz. Puzyna, J. Metelski (below), D. Augustyńska, I. Dąbrowski, R. Ciosek (1980).

Moreover, there were developed methods and test stands to measure and record vibrations at work stations, a prototype of a vibration perception meter (patent no. 57064), methods of noise examination of ultrasonic equipment and guidelines pertaining to the design of screens and enclosures for such devices, silencers for fluid flow machines and combustion engines (patent no. 66348), a prototype of an industrial soundproof cabin intended for buildings of high levels of noise, and other solutions pertaining to collective protective equipment (screens and spatial absorbers) and personal (first of all – hearing protectors).

At that time, the Department also developed methods of measurement and assessment of the infra- and ultrasonic noise hazards in the working environment. The results of the works constituted the grounds for development of a documentation and determination to the infra- and ultrasonic threshold limit value (TLV).

Beside theoretical studies and development of methods and draft standards, there were also designed pneumatic tools silencers, Ursus agricultural engines silencers and ventilation system silencers. The designs were many a time implemented.



Fig. 2. Vibration measurements on the ground – Plant of “Zamech” in Elbląg.
From the left: R. Ciosek, A. Czajka, Cz. Puzyna, R. Pilipkiewicz (1965).

Other works regarded development of a series of types of soundproof industrial cabins. Also works regarding methods of measurement and evaluation of infrasonic hazards in the working environment were carried out.

3. Coordination activity

Results of scientific and research works carried out at the Central Institute for Labour Protection have made it possible to perform comprehensive analyses of the level of vibroacoustic hazard in the working environment. The analyses became the starting material for the Committee for Science and Technology to

develop a resolution of the Council of Ministers of August 1971 on the intensification of efforts on noise and vibration control in the work environment in plants. Based on the resolution, “Programme Assumptions” were developed, followed by a framework programme of scientific, research, development and implementation works in the field of preventing noise and vibrations in the work environment in plants in the years 1971–1975. The programme included over 400 tasks realised by 116 science and research establishments, project teams and enterprises, its coordination was entrusted to the Central Institute for Labour Protection, and the Coordination Team was headed by Assistant Professor Czesław Puzyna.

Within several crucial problems coordinated by Central Institute for Labour Protection tasks regarding prevention of noise and vibration were distinguished. The former Department of Acoustics coordinated the research conducted by numerous scientific centres in the country, among others the Institute of Mechanics and Vibroacoustics of the AGH University of Science and Technology, the Building Research Institute, the Central Mining Institute, the Institute of Applied Mechanics of Cracow University of Technology, the Institute of Machine Design Fundamentals of Warsaw University of Technology, or the Institute of Physics of the University of Gdansk.

Also, under the long-term programme of harmonization of working conditions standards in Poland and the European Union, projects and tasks realised by several scientific centres were coordinated by the employees of the Department of Vibroacoustic Hazards of the Central Institute for Labour Protection – National Research Institute.

At present, the 2st stage of the “Improvement of working safety and conditions” programme is being realised, under which numerous works regarding prevention of noise and vibration are being conducted. Most of the aspects are being realised or coordinated by the Department of Vibroacoustic Hazards.

4. Scientific activity

Beside coordination and organisation activities, employees of the Central Institute for Labour Protection have above all been conducting an intense research activity with respect to widely-meant vibroacoustics. Substantial results of the activity include establishment of unique laboratories and development of numerous post-doctoral and doctoral theses by the employees of the Central Institute for Labour Protection as well as numerous valuable publications and lectures given at international congresses and scientific conferences.

In one paper it is impossible to discuss all the scientific accomplishments of the Central Institute for Labour Protection regarding the issues of vibroacoustic hazards. For this reason, below you will find but a few of them.

In the 1980s, the Central Institute for Labour Protection founded the first in Poland, unique laboratory of active methods of noise reduction.



Fig. 3. View of a stand for testing active noise reduction methods.

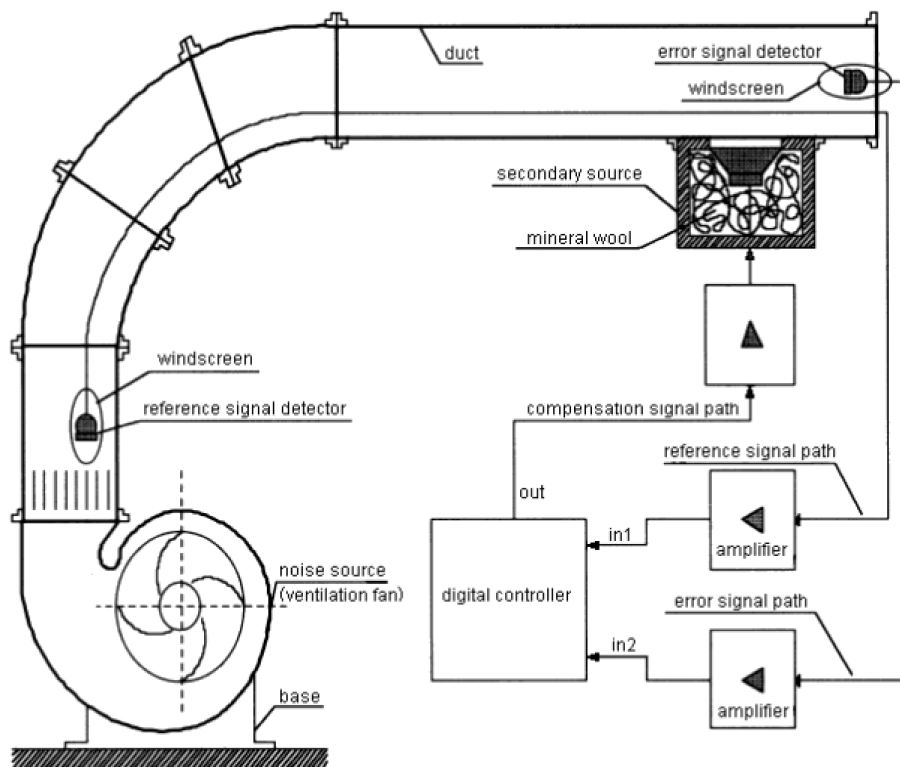


Fig. 4. Diagram of an active noise reduction system in a ventilation duct.

As a result of scientific research conducted at the Central Institute for Labour Protection, there have been developed and defended doctoral theses of: Czesław Puzyna, Danuta Augustyńska, Danuta Trynkowska, Ryszard Michalski, Wiktor M. Zawieska, Jolanta Koton, Dariusz Pleban, Grzegorz Makarewicz, Leszek Morzyński, Anna Kaczmarska, Piotr Kowalski, Witold Mikulski and Janusz Szopa.

Post-doctoral theses have been developed by: Danuta Koradecka on: "The impact of factors associated with work with a typical vibrating tool on the peripheral blood circulation"; Jan Żera on: "Perception of non-synchronicity of multitone spectral components"; and Wiktor M. Zawieska on: "Selected aspects of noise reduction exemplified by transformers".

Results of scientific works have been published in renowned scientific journals, such as: Archives of Acoustics, Acustica/Acta Acustica, Mechanics, Journal of Occupational Safety and Ergonomics, Applied Acoustics, Strojnický Casopis, The Journal of Low Frequency Noise and Vibration, or presented at world scientific congresses and conferences.

Numerous scientific monographs have been written, for instance

- Cz. Puzyna, *Acoustic problems in industrial plants* [in Polish: *Zagadnienia akustyczne w zakładach przemysłowych*], Wyd. Związkowe 1968.
- Cz. Puzyna, *The principles of noise control in the industry* [in Polish: *Zasady zwalczania hałasu w przemyśle*], WNT 1970.
- Cz. Puzyna, *Standardization in noise control* [in Polish: *Normalizacja w walce z hałasem*], Wyd. Normalizacyjne 1973.
- Cz. Puzyna, *Noise control in the industry – selected issues* [in Polish: *Zwalczanie hałasu w przemyśle – zagadnienia wybrane*], WNT 1974.
- D. Augustyńska, W.M. Zawieska *et al.*, *Protection against noise and vibration in the working environment* [in Polish: *Ochrona przed hałasem i drganiami w środowisku pracy*], Wyd. CIOP 1999.
- D. Augustyńska, D. Pleban, W. Mikulski, P. Tadzik, *Assessing the emission of noise by machines* [in Polish: *Ocena emisji hałasu maszyn. Wymagania, metody*], Wyd. CIOP 2000.
- Z. Engel, *The principle of correlation* [in Polish: *Zasada wzajemności*], Wyd. AGH 2000.
- Z. Engel, *Protecting the environment against vibration and noise* [in Polish: *Ochrona środowiska przed drganiami i hałasem*], PWN 2001.
- Z. Engel, G. Makarewicz, L. Morzyński, W.M. Zawieska, *Active methods of noise reduction* [in Polish: *Metody aktywne redukcji hałasu*], Wyd. CIOP 2001.
- Z. Engel, D. Pleban, *Noise emitted by machines and equipment – sources, assessment* [in Polish: *Hałas maszyn i urządzeń – źródła, ocena*], Wyd. CIOP 2001.
- G. Makarewicz, *Selected digital systems of active noise reduction* [in Polish: *Wybrane cyfrowe systemy aktywnej redukcji hałasu*], Wyd. CIOP 2002.

- Z. Engel, J. Piechowicz, D. Pleban, L. Stryczniewicz, *Minimizing industrial vibroacoustic hazards* [in Polish: *Minimalizacja przemysłowych zagrożeń wibroakustycznych*], Wyd. CIOP-PIB 2005.

5. Educational and organisational activity

The Central Institute for Labour Protection conducts intense educational and organisational activity related to prevention of noise and vibration. The 'NOISE CONTROL' International Conferences on Noise Prevention are an important part of the activity. Initially, employees of the Central Institute for Labour Protection actively participated in the conferences, gave lectures, headed sessions, and then co-organised them. Since 1998, the Central Institute for Labour Protection has been the main organiser of the NOISE CONTROL. In 1998, the Institute held the NOISE CONTROL conference in Krynica, followed by the 2001 conference held in Kielce, the 2004 conference held in Gdynia, the 2007 conference held in Elbląg and in 2010 conference held in Książ-Wałbrzych. Each conference was attended by approximately 150 people from many countries of the world. Also, special exhibitions and thematic sessions were held. Materials containing the papers presented at those conferences were published.



Fig. 5. Banquet held at the Royal Castle during the 1995 Noise Control Conference co-organised by Central Institute for Labour Protection. From the left: A. Rakowski, Z. Engel, D. Koradecka, J. Sadowski, M. Engel, A. Śliwiński.

In 2005, the Institute organised and coordinated the "Stop noise!" campaign. The campaign, supported by the European Parliament and the European Com-

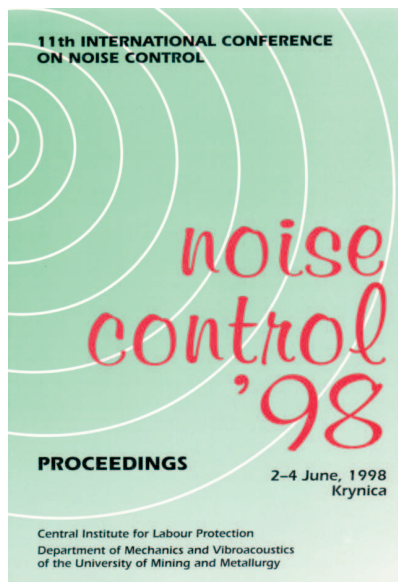


Fig. 6. Noise Control' 98 Conference materials.



Fig. 7. Cover page of the 'Stop noise!' campaign materials.



Fig. 8. Seminar held as part of the 'Stop noise!' campaign.

mission, was conducted concurrently throughout Europe and finished with the European Week of Occupational Health and Safety in October 2005. As part of the campaign, scientific conferences and seminars in Katowice, Poznań and

Cracow were held, and special educational picnics in Puławy and Lubawa were organized.

For many years now, the Central Institute for Labour Protection has been organising regular, national scientific seminars on selected aspects of acoustics and preventing noise and vibrations.

Many employees of the Central Institute for Labour Protection actively participate in organisational works outside the Institute. Members of the Committee on Acoustics of the Polish Academy of Sciences have included: Czesław Puzyna, Danuta Augustyńska, Zbigniew Engel, Dariusz Pleban, Jan Żera. D. Pleban actively participates in the works of the Group of Coordinators of the European Occupational Safety and Health Network EUROSNET.

Problems of preventing noise and vibration have been the subject matter of post-graduate studies systematically conducted by the Centre for Education of the Central Institute for Labour Protection for many years now. Among others, specialist training in the “Noise and vibration hazards in the working environment” has been conducted.

6. Standardisation activity and development of legal acts

Primary achievements of the Central Institute for Labour Protection include development of basic standards pertaining to prevention of noise and vibration. It ought to be clearly indicated that during the first years of the Institute’s activity there were no Polish standards pertaining to prevention of noise and vibration. Thus, on the one hand the employees of the Central Institute for Labour Protection undertook to develop unique standards and, on the other hand, to adapt foreign standards and adjust them to Polish conditions. In the 60 years of activity, employees of Central Institute for Labour Protection have actively participated in the works of the Polish Committee for Standardization. For example, Technical Committee no. 157 of the Polish Committee for Standardization for Physical Hazards in the Working Environment has its office at the Central Institute for Labour Protection, and the Committee is headed by Assistant Professor Danuta Augustyńska. Employees of Central Institute for Labour Protection participate in the works of the European Committee for Standardization – the Technical Committees CEN/TC 211 and 231. They also participate in the works of the Inter-Departmental Commission for Maximum Admissible Concentrations and Intensities for Agents Harmful to the Health in the Working Environment. In this paper it is not possible to discuss all the standards pertaining to the problems of preventing noise and vibration that has been developed by the Central Institute for Labour Protection. As an example, one may indicate that among others the Institute has developed such standards as:

- Guidelines regarding measurement and evaluation of exposure to noise in the working environment,

- Determination of sound power levels of noise sources,
- Noise emitted by machinery and equipment,
- Guidelines regarding noise reduction by enclosures and cabins.

Employees of the Central Institute for Labour Protection have actively participated in the development of legal acts pertaining to prevention of noise and vibration. Here, we ought to refer to the amendments to the Labour Code as well as development of the Environment Protection Law.

7. Summary

In a short article, it is impossible to present the entire, comprehensive activity of the Central Institute for Labour Protection with respect to protection of man against noise and vibration in the working environment.

During the last 60 years, besides educational and organisational activity, Central Institute for Labour Protection conducted extensive cooperation with numerous scientific and technical establishments dealing with the problems of vibroacoustic hazards in many countries of the world. Extensive cooperation involved numerous domestic establishments such as the Institute of Fundamental Technological Research of the Polish Academy of Sciences, the Building Research Institute, the Faculty of Mechanics and Vibroacoustics of the Academy of Technology, or the Central Mining Institute.

As far as international cooperation is concerned, one needs to refer to the International Institute of Noise Control Engineering and the International Institute of Sound and Vibration Research (Auburn Alabama, USA), the Institute of Sound and Vibration Research (Southampton, UK).

References

1. AUGUSTYŃSKA D. (2005), *Exposure to noise in the working environment* [in Polish: *Stan narażenia na hałas w środowisku pracy*], Ochrona środowiska przed hałasem w Polsce w świetle przepisów europejskich, Komitet Akustyki PAN, CIOP-PIB.
2. AUGUSTYŃSKA D. *et al.* (1982), *Infrasound noise in the working environment* [in Polish: *Hałas infradźwiękowy w środowisku pracy*], Materiały do Studiów i Badań, No. 62, CIOP.
3. AUGUSTYŃSKA D., KACZMARSKA A., MIKULSKI W., RADOSZ J. (2010), *Assessment of teachers' exposure to noise in selected primary schools*, Archives of Acoustics, **35**, 4, 521–542.
4. ENGEL Z. (1998), *Noise control in Poland in the last half century* [in Polish: *Zwalczanie hałasu w Polsce w ostatnim półwieczu*], Proceedings Noise-Control 98, Krynica, 13–57.
5. ENGEL Z., SADOWSKI J. (1985), *Noise and vibration hazard in Poland* (synthesis of a report) [in Polish: *Zagrożenie hałasem i wibracjami w Polsce* (raport podsumowujący)], Archives of Acoustics, **10**, 2, 199–212.

6. ENGEL Z., ZAWIESKA W.M. (2004), *The state of protection against noise in the environment in the year of Poland's accession to the European Union* [in Polish: *Ochrona przed hałasem w środowisku. Stan zagrożenia w roku wstąpienia Polski do Unii Europejskiej*], Proceedings Noise-Control 04, Gdynia, 29–46.
7. KOWALSKI P., ZAJĄC J. (2010), *Whole-body and hand-arm vibration in in-house transport*, Archives of Acoustics, **35**, 2, 183–190.
8. KOZŁOWSKI E., KOTARBIŃSKA E. (2007), *Laboratory objective method for noise reduction measurements of ear-muffs*, Archives of Acoustics, **32**, 2, 287–292.
9. KRUKOWICZ T. (2010), *Active noise control algorithm based on a neural network and nonlinear input-output system identification model*, Archives of Acoustics, **35**, 2, 191–202.
10. MAKAREWICZ G. (2004), *Genetic algorithm-based active noise control systems-simulations using internet*, Archives of Acoustics, **29**, 2, 177–189.
11. Occupational Safety Science and Practice, Special issue, CIOP-PIB, 2010.
12. PLEBAN D. (2004), *Experimental Modelling and research on vibroacoustic phenomena in machines*, Archives of Acoustics, **29**, 2, 219–233.
13. PLEBAN D. (2007), *Acoustic modelling of machines using the inversion method for the purposes of the acoustic assessment of machines*, Archives of Acoustics, **32**, 2, 321–327.
14. PLEBAN D. (2010), *Method of acoustic assessment of machinery based on global acoustic quality index*, Archives of Acoustics, **35**, 2, 223–235.
15. RDZANEK JR. W.P., ZAWIESKA W.M. (2004), *The total sound power radiated by a clamped-guided annular plate excited for vibrations by an external surface pressure*, Archives of Acoustics, **29**, 2, 235–242.
16. SMAGOWSKA B. (2010), *Noise at workplaces in the call center*, Archives of Acoustics, **35**, 2, 253–264.
17. ZAWIESKA W.M. (2004), *Active noise control methods in Poland*, Archives of Acoustics, **29**, 2, 317–345.
18. ZAWIESKA W.M., RDZANEK W.P. (2007), *The influence of a vibrating rectangular piston on the acoustic power radiated by a rectangular plate*, Archives of Acoustics, **32**, 2, 405–415.
19. ŻERA J., MŁYŃSKI R. (2004), *Attenuation of outside noise by shotblasting helmets*, Archives of Acoustics, **29**, 2, 347–358.