

Projects of the planned and ongoing National Agency include topics such as: advanced robotics and AI-based task automation, automation of cognitive and physical tasks, changing job content, collaborative robots - direct interaction between human and robot, new forms of management workers' activities, algorithm-based systems, analysis, knowledge through complex games-knowledge, new monitoring systems for workers' health and safety.

In the medium and long term, we want to change the potential of the work environment, the mentality, the acquisition of skills to manage, to use the new tools that involve an improvement of e-learning.

Digitization helps to develop performance and allows unlimited solutions within companies, helps to create new business concepts, which means progress but to achieve this goal, the interest must be common, both on the part of the employee and the employer and desire to adaptation.

To help companies that do not have a budget and want to use modern tools, there is the European Non-Reimbursable Financing Program - Digitization of SMEs.

5. Bibliography

- [1] Law on safety and health at work - 319/2006
- [2] GEO no. 36/2021
- [3] H.G. 1425/2006
- [4] Law no. 53/2003 - Labor Code
- [5] Law 208 / 22.07.2021
- [6] EU Regulation 910/2014 of 23 July 2014 on electronic identification
- [7] <https://osha.europa.eu/en/themes/digitalisation-work>
- [8] Rapport Santé et Sécurité au travail 2021 - <https://www.societegenerale.com/fr>
- [9] https://m.bvb.ro/infocont/infocont22/BRD_20220428170959_BRD-Raport-anual-2021-RO.pdf
- [10] <https://www.cartel-alfa.ro/ro/comunicate-57/28-aprilie-ziua-comemorarii-victimelor-accidentelor-de-munca>

NOISE EXPOSURE FOR GROUND OPERATIONS MARSHALLER IN INTERACTIONS WITH SMALL AIRCRAFTS

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Synopsys: Case study about noise exposure, measurements and actions to prevent noise exposure for the ground operations, workplace at the airport. The noise level is determined by measuring the sound pressure, which is expressed in Decibels (dB). As the number of decibels increases, the noise becomes harder to bear. The human ear can perceive sounds with an intensity between 0 and 120 decibels. Usually, the level of 20-30 decibels is harmless to the human body and as it grows, it becomes tiring or stressful (especially in the case of exposure for a longer period of time).

KEYWORDS: Noise exposure, measurements, measures, prevention

1. Introduction

Noise in the workplace is a widespread global issue. In Europe, for example, tens of millions of workers have hearing problems caused by high-noise work environments. Approximately one third of the total occupational diseases registered both in Romania and in the European Union are represented by hearing loss caused by noise.

But what exactly is noise? Noise is a form of noise pollution consisting of polluting hearing aids (sounds) that, in duration and amplitude, can harm health through hearing disorders. Noise is mainly produced by the operation of industrial equipment, especially motorized ones but also by strongly amplified music. Some of the health conditions caused can have irreversible effects on the human body. The following are some examples of the effects of noise exposure, as per the Noise Exposure Risk Prevention Campaign conducted by the Romanian Labor Inspectorate [1]:

- Hearing loss - deafness, caused by the destruction of the inner ear's cilia.
- Tinnitus - is the annoying auditory sensation of whistling, hissing, whining, humming.
- Disruption of verbal communication - Ambient noise is often felt as a disruption of verbal communication, especially if the listener is already hearing impaired or if ambient noise covers the speaker's voice.
- Increased risk of injury - Noise is a risk of injury as it may prevent workers from hearing and / or understanding communication and signaling correctly at work or in traffic. For example, noise may distract from the audible warning signal of imminent danger or may generally distract, especially in the case of drivers.
- Psychological disturbances - ambient noise can be very disturbing, especially when the worker is carrying out an activity that involves focusing attention. The frequency of errors and uncertainty increase if the activity takes place in a noisy environment.
- Physiological effects - Exposure to noise can cause fatigue, digestive, cardiovascular (high blood pressure) and neuropsychiatric (stress) disorders.

Considering the effects caused by exposure to noise on the human body, the legal provisions aim to reduce the risk of hearing loss by reducing the noise level, preferably at the source, and by using hearing protection equipment.

2. The current stage

In a concerted effort to combat the effects of noise exposure of workers, the European Union has updated the previous Noise Directive 86/188 / EEC with a new Directive 2003/10 / EC which:

- provides increased protection for workers in all sectors of the economy, including the maritime and air transport sectors (excluded from the existing Directive 86/188/EEC).

- recognizes the specificity of the music and entertainment sectors by providing for a two-year transitional period during which codes of conduct shall be established for helping workers and employers in these sectors to meet their legal obligations as laid down by the directive.
- reduces the exposure limit value from 90 dB(A), as set up in the 1986 directive, to 87 dB(A), which represents clear progress.

In Romania, the minimum requirements regarding the exposure of workers to noise are specified by GD (government decision) 493/2006, a decision which took over the provisions of EU Directive 10/2003.

GD 493/2006 set out the minimum requirements for the protection of workers from the risks arising from exposure to noise, in particular against the risks of hearing. The provisions of this decision also apply to all activities in which workers are or are likely to be exposed by the nature of their work to the risks generated by noise.

The physical parameters used as risk factors are as follows:

- the level of daily noise exposure ($L_{Ex,8h}$) (dBA) – time-weighted average of noise exposure levels for a nominal working day of 8 hours.

This notion covers all the noises within the workplace, including impulse noise.

- weekly noise exposure level ($L_{Ex,8h}$) (dBA) time-weighted average daily noise exposure levels in a nominal 5 days' work week of 8 hours each day.

The exposure limit values and the values from which the employer's action on health and safety protection of workers is triggered are as follows:

- exposure limit values: $L_{Ex,8h} = 87$ dBA and peak pressure $P_{v\grave{a}r\grave{f}} = 200$ Pa (Pascals)
- upper exposure limit values from which the action is triggered: $L_{Ex,8h} = 85$ dBA and peak pressure $P_{v\grave{a}r\grave{f}} = 140$ Pa (Pascals)
- lower exposure limit values from which the action is triggered: $L_{Ex,8h} = 80$ dBA and peak pressure $P_{v\grave{a}r\grave{f}} = 112$ Pa (Pascals)

3. Noise determinations at Ground Operations company

The noise exposure assessment is one of the concerns of Ground Operations company, as a first step in anticipating workplace noise hazards and the application of prevention principles and has been carried out in accordance with the legal requirements [2], [3], [4] and the applicable standards [5].



Fig. 1. Dauphin helicopter

The benefits of noise measurement are very important because it allows a scientific and accurate analysis of hurtful noise.

Acoustic measurements clearly indicate the extent to which hearing loss may be caused and allow corrective action to be taken. The measurements allow the analysis of noise and the elaboration of solutions, diagnoses in the program of reducing the exposure in the case of the

work environment but also outside it, all these leading to the improvement of the quality of life and human activity.



Fig. 2. ATR 45 aircraft

The method used for measuring and determining the noise exposure was that established by the standard SR EN ISO 9612: 2009 “Acoustics - Determination of occupational noise exposure - Engineering method”

Noise measurements are performed with special devices called sound level meters or dosimeters. The sound level meter is an instrument that has a response to acoustic signals of the same shape as the human ear. The dosimeter can be used for measurements in all types of work conditions.

This is the preferred method when performing long-term measurements for a mobile worker who is engaged in complex or unpredictable tasks or who performs a large number of direct tasks.

The sound level meter can be used to measure a single or multiple tasks within fixed work places. The microphone must be mounted above the shoulder at least 0.1 m from the entrance to the inner ear canal, on the side with the ear most exposed, and must be at least 0.04 m above the shoulder.

In this case, the following portable devices were used to determine and evaluate the noise exposure (Figure 3):



Fig.3. Portable noise measuring devices

- Brüel&Kjaer dosimeter type 4448 (Figure 4);
- Brüel&Kjaer acoustic calibrator type 4231;
- Brüel&Kjaer sound level meter type 2250;

The equipment used complies with the legal requirements on metrological verification and calibration according to SR EN ISO 170254/2005 and has been calibrated with the Brüel&Kjaer acoustic calibrator type 4231.

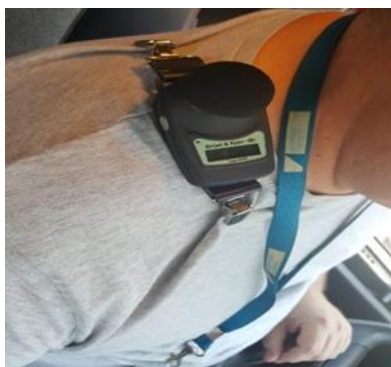


Fig 4. Brüel&Kjaer dosimeter type 4448

Analysis and interpretation of the results of noise determinations

The analysis and interpretation of the results of the noise determinations were based on them:

- the measurements carried out,
- the specific activities carried out by the workers,
- the measurement method established by SR EN ISO 9612” Acoustics - Determination of occupational noise exposure - Engineering method "
- minimum legal requirements established by GD 493/2006, amended and supplemented by GD 601/2007

In this regard, the actual day-to-day noise exposure was taken into account in determining the equivalent continuous noise level and the information provided by Ground Operations company on the representative duration of exposure specific to each activity performed by the workers.

The following are the noise test reports and measurement results for airplane guiding activities (Table 1. and Table 2.), helicopter guiding activities (Table 3. and Table 4.) and auxiliary activities (Table 5. and Table 6)

Table 1. Noise test report - airplane control activities

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	05/07/2021 – 09/07/2021
Job description	Job: aircraft marshaller
	Schedule: 12h/shift
	Neuropsychic and psychosensory stress: Especially for dispatching activity
Used equipment	Dosimeter Brüel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table 2. Measurement results - aircraft control activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week
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Steering on the platform with the KIA Sportage car at ATR 45 aircraft	86,9	3 h.
Platform steering with KIA Sportage at Boeing 737 aircraft	89,2	
Direction and monitoring activities, control tower enclosure	65,2	3 h.

Daily exposure: $L_{E,z} = 87\text{dBA}$

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:

- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Table 3. Noise test report - Helicopter traffic services

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	12/07/2021 – 16/07/2021
Job description	Job: aircraft marshaller
	Schedule: 12h/shift
	Neuropsychic and psychosensory stress: Especially for dispatching activity
Used equipment	Dosimeter Brüel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table 4. Measurement results - Helicopter control activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week
Steering on the platform with KIA Sportage car on the Falcon 10 aircraft	78,8	15 min.
Platform steering with the KIA Sportage FollowMe1 at the Dauphin helicopter (Figure 1)	80,3	30 min.
Directing and monitoring activities, outdoor office premises	70,9	8 h + 30 min.

Daily exposure: $L_{E,z} = 72\text{ dBA}$

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:

- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Table.5. Noise test report - auxiliary activities

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	19/07/2021 – 23/07/2021
Job description	Job: Deputy Commander
	Schedule: 12h/shift

	Neuropsychic and psychosensory stress: Outstanding for office work
Used equipment	Dosimeter Brüel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table.6. Measurement results - auxiliary activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week
Outdoor office activities	70,8	4 h.
Surface monitoring activities in the KIA Sportage	72,4	4 h.

Daily exposure: $L_{E,z} = 71$ dBA

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:

- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Proposed measures to reduce workers' exposure to noise-related risk factors

Noise determinations performed at Ground Operations do not show values above the maximum permissible noise exposure limit at the workplace.



Fig 5. Ground marshalling

Even if the daily noise exposure is not exceeded, during the noise measurements there have been identified values above the lower and upper permissible maximum limit from which the action is triggered according to the legal provisions [7] at Otopeni Airport (see noise test reports).



Fig 6. Platform guidance

Also, during the performance of specific work tasks, such as those of the road maintenance personnel, the noise levels during the operation of various equipment (e.g. jackhammer, compactor plate, joint cutter, cleaning machine, marking machines, tractor with shredders, mower) has values above the maximum permissible limit of 87 dBA.

In both of the above situations, in order to reduce noise exposure, the employer will apply the legislative provisions regarding the reduction of noise exposure. [8]

Another situation is represented by the noise level determined in certain rooms existing at the workplace, such as: control tower ground dispatcher, office - deputy commander, container - ground dispatcher, which exceeds the value of the level of continuous noise equivalent L_{ech} daily 60 dBA set of GD 601/2007 [9] on jobs with special neuropsychic and psychosensory demands. In this case the employer will apply the legal prevention measures regarding the reduction of the risks generated by the noise exposure. [11]

Exposure to noise above certain limits is a factor of professional deafness, a biological aggression, a medical-social nuisance with implications of prime importance in terms of health and work capacity. The strong noise sources existing at the investigated workplaces put their mark on the daily exposure of the workers during the whole work shift.

1. Conclusions

The necessary measures to be taken to create a workplace environment in terms of noise protection at work on the airport platform are, in principle: noise risk assessment, prevention of exposure, including the use of personal protective equipment, limitation of exposure to noise in accordance with the exposure limit levels and the levels from which the action is triggered and the information, consultation and participation of workers. Beyond the solutions adopted, be they technical and / or organizational, to reduce exposure to noise, the following must be taken into account: avoiding the risk of occupational injury and illness, assessing the risks that cannot be avoided, combating risks at source, adapting tasks work for each worker, adapting to existing technical advances and replacing hazardous exposure with less hazardous or non-hazardous exposure;

In order to reduce cases of hearing loss due to noise, it is necessary to involve all parties directly or indirectly connected to the work process, namely: employers, workers, public authorities, health services, labor inspection services.

It is important to note that the Community strategy for health and safety at work, supported by the Council and the European Parliament, emphasized the idea of consolidating

and effectively enforcing Community law by applying all available levers to promote and acquire good practice beyond simple observance of the existing provisions [10].

Bibliography

- [1]. Risks related to exposure to noise at work - Romanian Labor Inspectorate - Brochure, January 2007
- [2]. GD No. 493/2006 on minimum safety and health requirements regarding the exposure of workers to the risks posed by noise.
- [3]. GD No. 601/2007 for the amendment and completion of some regulatory decision on occupational safety and health.
- [4]. GD No. 1048/2006 on the minimum safety and health requirements for workers using personal protective equipment at work.
- [5]. SR EN ISO 9612: 2009 "Acoustics - Determination of occupational noise exposure - Engineering method"
- [6]. Photo source: www.pexels.com
- [7]. GD 493/2006 on the minimum safety and health requirements regarding the exposure of workers to the risks generated by noise, art. 5, letter b, and c.
- [8]. GD 493/2006 on the minimum safety and health requirements regarding the exposure of workers to the risks generated by noise, chap. II, art.17, 18, 19, 20, 21, as well as the provisions of chap. II art. 23, 24, 25, 26, 27 of the same regulatory decision.
- [9]. GD 601/2007 for the modification and completion of some regulatory decisions on occupational safety and health.
- [10]. GD 493/2006 regarding the minimum safety and health requirements regarding the exposure of workers to the risks generated by noise, art. 18 let. e).
- [11]. NOISE AT WORK - Magazine of the European Agency for Safety and Health at Work 8 / EN