

## NOISE LEVELS IN WORKPLACES OF COLD ROLLING MILL PLANT

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### ABSTRACT

*The excessive noise exposure is one of numerous physical hazards present in the steel industry. Considerable noise develops the steel strips rolling process. In this study are presented and discussed the noise levels at different working areas of a cold rolling mill plant. The average of annual values of noise levels is given. The annual overall values of equivalent sound levels were calculated. These are discussed in relation with the noise exposure level normalized to a normal 8hr working day allowed by standards. The results revealed that workers at numerous roll milling plant areas are exposed to noise levels higher than 87 dB(A) 8 - hour standard. As a result, at the end of the paper some specific measures to diminish noise levels are proposed.*

**KEYWORDS:** steel strips, cold rolling mill, working areas, occupational noise

### 1. Introduction

A typical major source of noise in the steel industry is the hot or cold rolling processes. The sub-processes related to cold rolling mill within an integrated steel mill includes the surface preparation (pickling), trimming and oiling, cold rolling, degreasing and heating processes (annealing) [1, 2]. Many of these processes are noisy and may cause disturbance to the workplaces. Consequently, the noise is a typical environmental issue for rolling mill plants and requires continuous monitoring [3].

For this reason, noise pollution for workers in the steel industry is a great concern in world. The industrial noise from steel rolling mills induces to workers' deafness and hearing impairments [4, 5]. The European Union has established a common policy aimed at controlling the risks due to the exposure of workers to noise. EU has introduced specific legislation that provides the measures to minimize and even reduce it (Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise with successive amendments and corrections that have been incorporated into the original text (<http://eur-lex.europa.eu/>). Its Romanian national transposition is achieved through the adoption of various legislative acts.

The limits of exposure time for continuous noise for occupational health issues are related by International Standards. The terms used for Occupational Exposure Levels in the European Union are following: daily personal noise exposure of a worker -  $L_{EP,d}$  (noise exposure level normalized to a normal 8hr working day); weekly average of the daily values  $L_{EP,w}$ . If the hearing damage is proportional to the acoustic energy received by the ear, then an exposure to a particular noise level for one hour will result in the same damage as an exposure for two hours to a noise level which is 3 dB lower than the original level. This is referred to the 3 dB(A) trading rule and is generally accepted in many parts of the world. However, 4 dB(A) and 5 dB(A) rules exist in the USA and the purpose of this section is to discuss the relative merits of the various trading rules in current use [6].

Several European countries followed limits adopted by the ISO standard. These are known as "the 3 dB(A) rule" [7]. USA respect the levels imposed by Occupational Safety and Health Administration – OSHA, so-called "the 5 dB(A) rule" [8, 9]. The OHS Noise Regulations set exposure levels commonly referred to as 85 dB(A)Leq for an averaged over an eight-hour period and a maximum or peak noise level of 140 dB(C) [7, 10].

In addition to the European nations, most other nations around the world have adopted the 3-dBA ER. Table 2 shows the PEL and ER used by various

nations, along with the date of their standards or regulations, when available.

**Table 1.** Permissible exposure limits (PEL) and exchange rates used by various nations [11]

Nation, date	PEL (8-hour-average) dBA	Exchange rate dBA	Level dBA engineering controls	Level dBA audio tests, and other HC practices
Argentina, 2003	85	3	85	85
Australia, 2000	85	3	85	85
Brasil, 1992	85	5	85	
Canada, 1991	87	3	87	84
Chile, 2000	85	3		
China, 1985	85	3	85	
Colombia, 1990	85	5		
EU, 2003	87	3	85	85
Finland, 1982	85	3	85	
France, 1990	85	3		85
Germany, 1990	85	3	90	85
Hungary	85	3	90	
India, 1989	90			
Israel, 1984	85	5		
Italy, 1990	85	3	90	85
Mexico, 2001	85	3	90	80
Netherlands, 1987	80	3	85	85
New Zealand, 1995	85	3		80
Norway, 1982	85	3		80
Spain, 1989	85	3	90	80
Sweden, 1992	85	3	85	85
United Kingdom, 1989	85	3	90	85
United States, 1983	90	5	90	85
Uruguay, 1988	85	3	85	85
Venezuela	85	3		

The typical noise levels associated with the individual process at steel plants range between 59 and 84 dBA, while the combined noise levels for entire steel complexes range between 90 and 92 dBA [12]. The effective noise level generated by hot and cold rolling mill is 95-110 dB(A) [13].

Other studies give the general level of operating noises around 84-90dBA and peaks to 115 dBA [14].

This study presents and discusses the noise levels at different working areas of a cold rolling mill plant. The average of annual values of noise levels is given. with the discussion is related to the noise exposure level normalized to a normal 8hr working day allowed by standards.

## 2. Experimental method

The noise levels in workplaces of cold rolling plant were measured with the noise dosimeter with measuring range of 20-140 dB (Cirrus Research plc).

The annual overall values of equivalent sound levels were calculated and compared with the regulatory limit from the Romanian Noise Regulations (HG 493/12.04.2006 about occupational safety and health regarding the exposure of workers to the risks arising from noise). This regulation establishes the exposure limit values and exposure values which trigger the action of employer on safety and health protection in relation to daily noise exposure levels and peak sound pressure. These values are as follow:

- Noise exposure limit level:  $L(EX, 8hr) = 87dB(A)$  and sound pressure  $p(\text{peak}) = 200 \text{ Pa}$  (140 dB(C) at reference sound pressure in air  $20 \mu\text{Pa}$ ), respectively;

- Maximum exposure level which triggers the action:  $L(EX, 8hr) = 85 \text{ dB(A)}$  and respectively sound pressure  $p(\text{peak}) = 140 \text{ Pa}$  (137 dB(C) at reference sound pressure in air  $20 \mu\text{Pa}$ );

- Minimum exposure level which triggers the action:  $L(EX, 8hr) = 80 \text{ dB(A)}$  and the sound pressure

$p(\text{peak}) = 140 \text{ Pa}$  (135 dB(C) at reference sound pressure in air  $20 \mu\text{Pa}$ ), respectively.

### 3. Results and Discussion

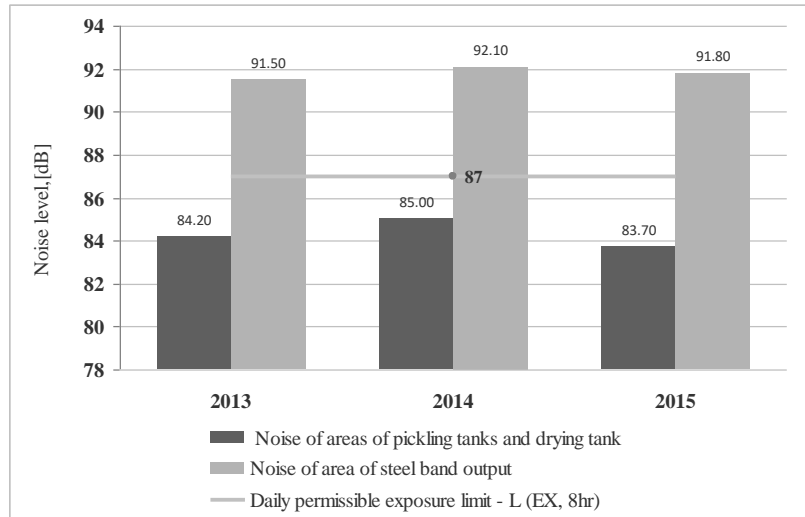
In the entire rolling zone develop noise. The principal sources of noise are the gearbox of the rolls and straightening machines, the pressure water pumps, the shears and saws, the throwing of the

finished products into a pit and the stopping movements of the material with metal plates [14].

In respect to these aspects, the levels of noise from different working areas are presented. This is compared with the daily permissible exposure limit - L(EX, 8hr) considered for working spaces of roll milling plants (87dB). In addition, the values from other sectors of the cold rolling mill plant are presented. The average of annual values of noise levels for pickling sector are given in Table 2 and Figure 1.

**Table 2.** Annual overall values of equivalent sound level inside pickling sector

Source of noise		NAEC dB(A)		
		2013	2014	2015
Pickling line	areas of pickling tanks and drying tank	84.2	85	83.7
	area of steel band output	91.5	92.1	91.8



**Fig. 1.** Overall values of equivalent sound level for surface preparation sector from cold rolling mill plant

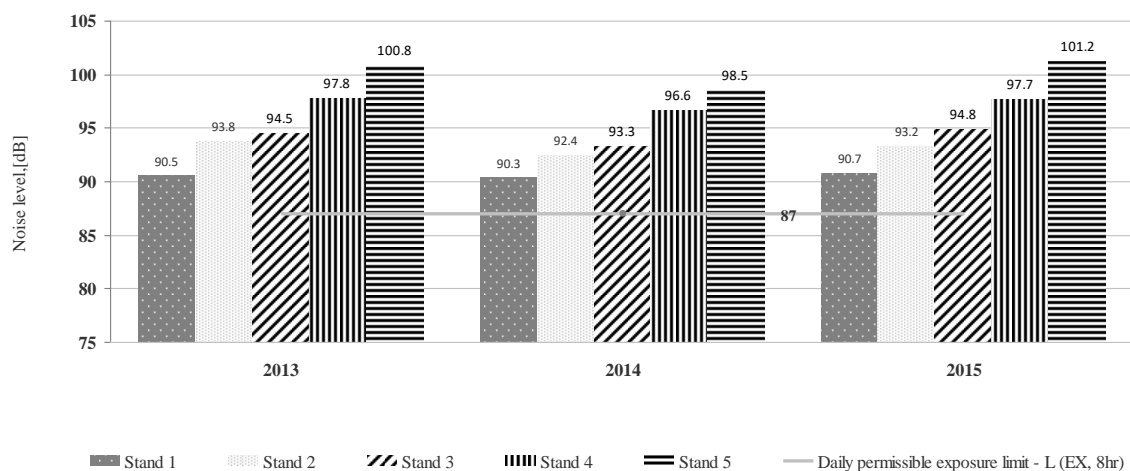
The exceedances of noise limit values are recorded in the output of the sheet strips from the pickling operation. These have been observed all along the years.

In the tandem rolling mill stands for all vertically stacked rolls, the average levels of noise

exposure level normalized to a normal 8hr working day are higher than the permissible exposure limit (Table 3 and Figure 2). The maximum exposure level which triggers the action is exceeded. The steel strip that moves quickly over steel rollers produces noise.

**Table 3.** Annual overall values of equivalent sound level for tandem mill sector

Source of noise		NAEC dB(A)		
		2013	2014	2015
Stands of tandem mill	1	90.5	90.3	90.7
	2	93.8	92.4	93.2
	3	94.5	93.3	94.8
	4	97.8	96.6	97.7
	5	100.8	98.5	101.2



**Fig. 2.** Sound level for tandem mill

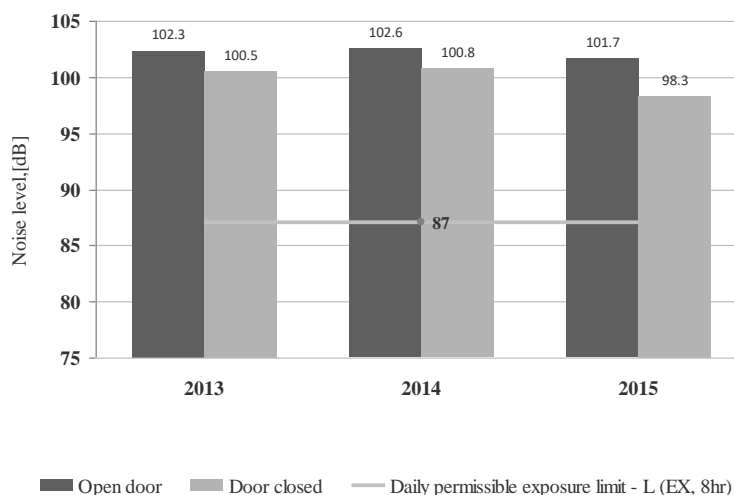
In the temper pas rolling sector the noise exceeds the permissible level developed (Table 4 and Figure 3). It has been observed that the sector of rolls machining is not so noisy. Near to straightening machines the noise levels were below standard limits. These were slightly above the permissible level for

the area around the blast cleaning machine (Table 5, Figure 4).

Also inside the pumps room from water household the noise level is higher (Table 6 and Figure 5).

**Table 4.** Annual overall values of equivalent sound level into area of temper pas rolling sector

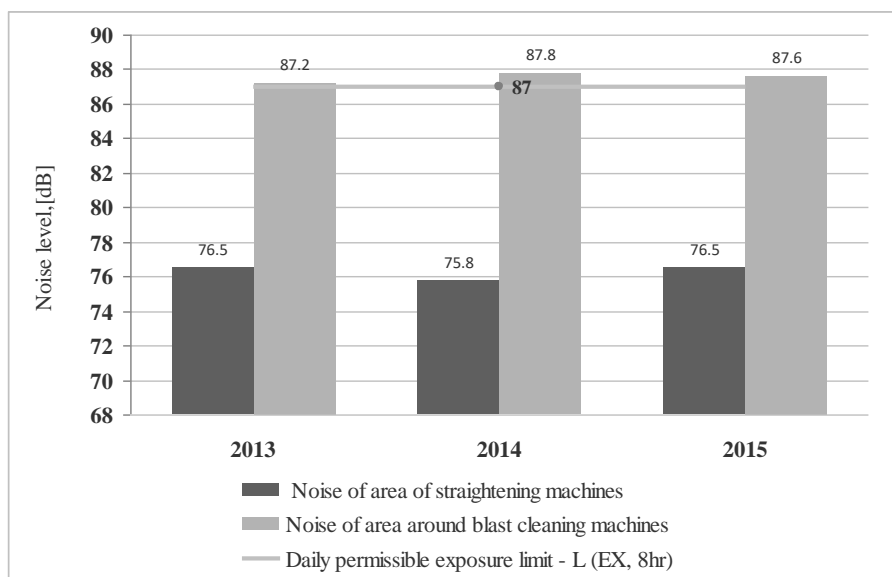
Source of noise		NAEC dB(A)		
		2013	2014	2015
Milling stand of temper pas rolling operation	open door	102.3	102.6	101.7
	door closed	100.5	100.8	98.3



**Fig. 3.** Noise level inside of temper-pas rolling sector

**Table 5.** Annual overall values of equivalent sound level for sector of machining of rolls

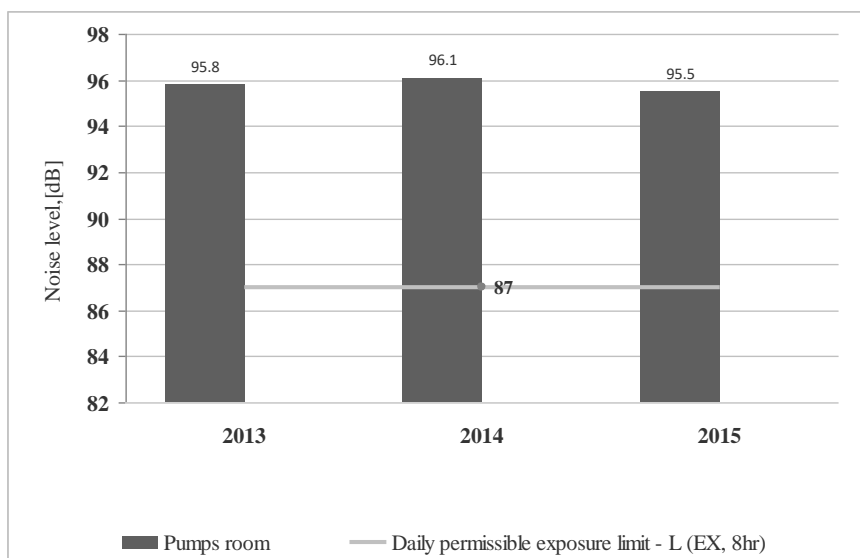
Source of noise		NAEC dB(A)		
		2013	2014	2015
Machining sector of rolls	area of straightening machines	76.5	75.8	76.5
	area around blast cleaning machines	87.2	87.8	87.6



**Fig. 4.** Sound level for machining sector of rolls

**Table 6.** Annual overall values of equivalent sound level for sector of pumps room from water household which serves the rolling mill plant

Source of noise	NAEC dB(A)		
	2013	2014	2015
Pumps room	95.8	96.1	95.5



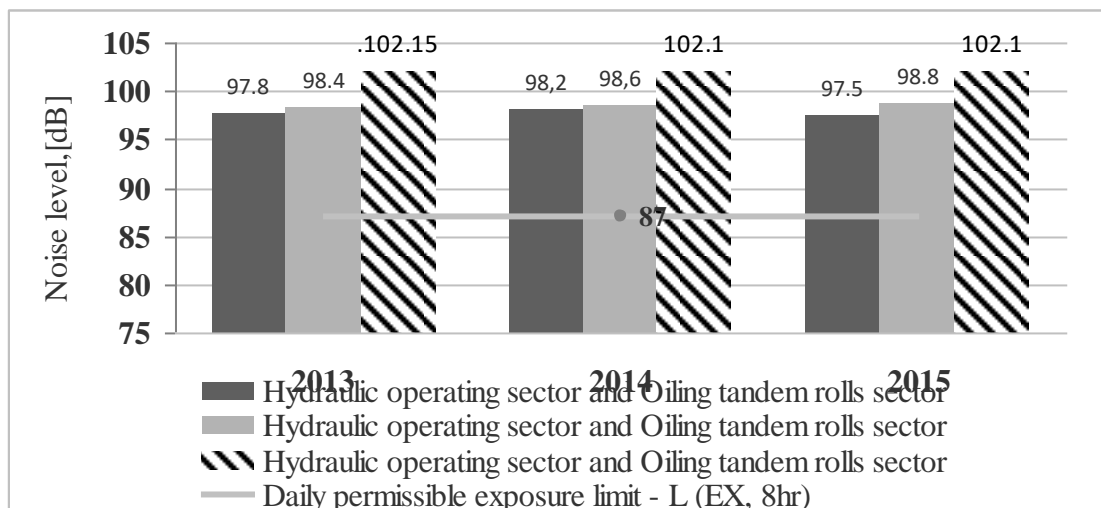
**Fig. 5.** Noise level inside pumps room from water household

Also inside the area from the hydraulic operating sector and from the sector of oiling tandem rolls the noise level recorded was higher with 10 and

15 dB over the daily permissible exposure limit (Table 7 and Figure 6).

**Table 7.** Annual overall values of equivalent sound level for hydraulic operating sector and oiling tandem rolls of mill

Source of noise	NAEC dB(A)		
	2013	2014	2015
Hydraulic operating sector and Oiling tandem rolls sector	97.8	98.2	97.5
	98.4	98.6	98.8
	102.5	102.1	102.1



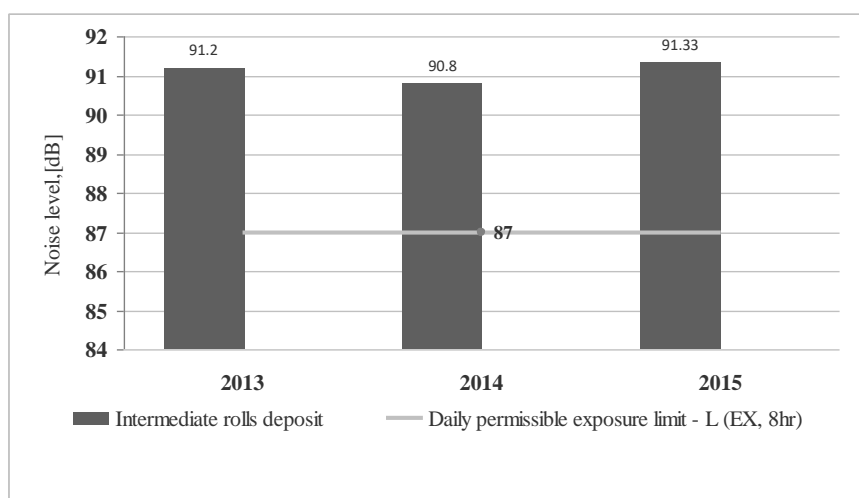
**Fig. 6.** Noise level inside of hydraulic operating sector and in area of oiling tandem rolls

Even in the intermediate rolls deposit the noise level was exceeded (Table 8 and Figure 7). The product movement in stockyards, loading vehicles

and vehicle movements are sources of noises. The noise level was slightly exceeded inside the steel strips adjustment area (Table 9 and Figure 8).

**Table 8.** Annual overall values of equivalent sound level for intermediate rolls deposit

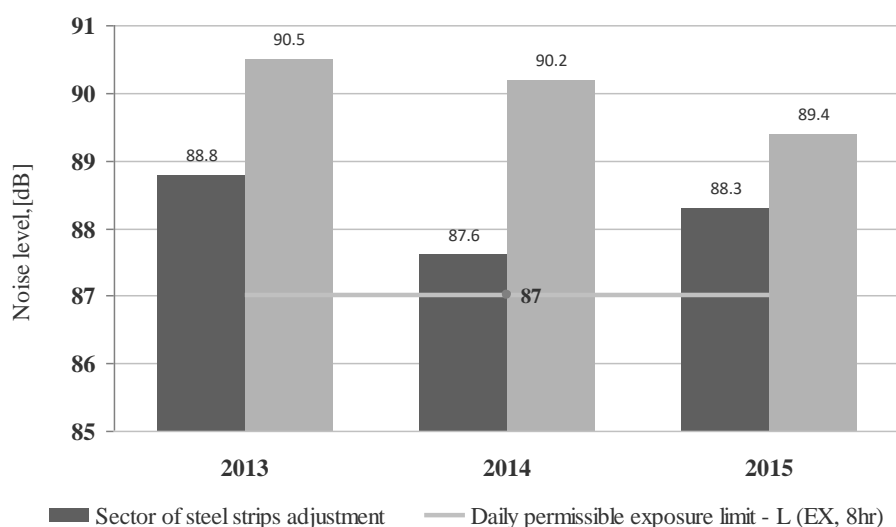
Source of noise	NAEC dB(A)		
	2013	2014	2015
Intermediate rolls deposit	91.2	90.8	91.33



**Fig. 7.** Noise level inside of intermediate deposit for steel strips rolls

**Table 9.** Noise level inside adjustment area

Source of noise	NAEC dB(A)		
	2013	2014	2015
Sector of steel strips adjustment	88.8	87.6	88.3
	90.5	90.2	89.4



**Fig. 8.** Noise level inside adjustment area

#### 4. Conclusions

The average noise exposure levels inside many sectors of cold steel-rolling mill were significantly higher. The results revealed that workers at numerous roll milling plat areas are exposed to noise levels higher than 87 dB(A) 8 - hour standard. To protect the workplaces from noise the effective anti-noise measures can be accordingly formulated and implemented. There is a need for employee training on noise exposure hazards and enforcement of the use of protective devices. The plant should be extensively automated. The machines and equipment demand maintenance and, the workers need personal protection. Particular attention should be paid to rollers and handling, cutting and grinding activities.

#### Acknowledgements

The authors wish to thank the student Basoc Monica who helped us in this study.

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N°. 4 - 2015, ISSN 1453 – 083X

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