Chapter 7 Noise level evaluation in the resin figures manufacturing process

Capítulo 7 Evaluación del nivel de ruido en el proceso de fabricación de figuras de resina

GARCÍA-SANCHEZ, Viviano†´, MALDONADO-ONOFRE, Daniel*´´, MIER-QUIROGA, Luis Antonio´´ and COUTIÑO-MORENO, Elvis´´

´Instituto Tecnológico de Toluca, State of Mexico, Mexico.

´´ Tecnológico de Estudios Superiores de Jocotitlán, Department of Electromechanical Engineering, State of Mexico, Mexico.

´´´ Tecnológico de Estudios Superiores de Jocotitlán

ID 1st Author: *Viviano, García-Sánchez*

ID 1st Co-author: *Daniel, Maldonado-Onofre* / **ORC ID**: 0000-0002-6078-2206

ID 2nd Co-author: *Luis Antonio, Mier-Quiroga* / **ORC ID**: 0000-0001-8290-4115

ID 3rd Co-author: *Elvis, Coutiño-Moreno* / **ORC ID**: 0000-0003-2455-2574

DOI: 10.35429/H.2021.9.1.114.128

V. García, D. Maldonado, T. De la Mora, L. Mier and E. Coutiño

* daniel.maldonado@tesjo.edu.mx

A. Ledesma (Coord.). Engineering Science and Technology. Handbooks-©ECORFAN-México, Estado de México, 2021.

Abstract

The investigation allowed the evaluation of the levels of noise in dedicated factories to the manufacture of decorativas resin figures, located in a population of the north of the Municipality of Toluca State Capital of Mexico. The study was developed with the objective to count on a reference mechanism to prevent risks to the health derived from the level with exhibition to the noise generated in this type of facilities, in such a way that the proprietors can protect to their personnel guaranteeing the development of their activities and not see themselves involved in labor demands. The investigation was limited the study of a single factory solely that is representative of the activities that are made normally in all the factories located in the zone, of which exist more than 50. For the measurements of the noise level, an integrating sound level meter was used type 2, of mark CEL Instruments® model CEL-328 and for the calibration of this was used an acoustic calipers mark CEL Instruments®, model CEL-282, series 2/11616221; the measurements and calibration were made taking in account the effective legislation in the matter of noise according to the Official Norm Mexicana NOM-011- STPS-2001, Conditions of Security and Hygiene in the Centers of Work Where Noise Is generated. Of the analysis of results it was observed that the level of noise in the areas of rectified and music, was with a NSCEAT, greater of 90 dB and in the remaining areas was smaller, but require of preventive measures since all presented/displayed 80 a greater NSCE of dB. In general the level of exhibition to the noise (NER) of the factory is of 86,6 dB, this value according to the norm applied in this study is necessary to implement some measures that allow to diminish the levels of noise with the purpose of avoiding labor diseases derived from the noise.

Noise level analysis, Noise, Risk

Resumen

La investigación permitió evaluar los niveles de ruido en talleres dedicados a la fabricación de figuras decorativas de resina, ubicados en una población del norte del Municipio de Toluca Estado de México. El estudio se desarrolló con el objetivo de contar con un mecanismo de referencia para prevenir riesgos a la salud derivados del nivel con exposición al ruido generado en este tipo de instalaciones, de tal manera que los propietarios puedan proteger a su personal garantizando el desarrollo de sus actividades y no se vean involucrados en demandas laborales. La investigación se limitó al estudio de una sola fábrica que es representativa de las actividades que se realizan normalmente en todas las fábricas ubicadas en la zona, de las cuales existen más de 50. Para las mediciones del nivel de ruido, se utilizó un sonómetro integrador tipo 2, de marca CEL Instruments® modelo CEL-328 y para la calibración de éste se utilizó un calibrador acústico marca CEL Instruments®, modelo CEL-282, serie 2/11616221; las mediciones y calibración se realizaron tomando en cuenta la legislación vigente en materia de ruido de acuerdo a la Norma Oficial Mexicana NOM-011- STPS-2001, Condiciones de Seguridad e Higiene en los Centros de Trabajo donde se genera Ruido. Del análisis de resultados se observó que el nivel de ruido en las áreas de rectificado y música, fue con un NSCEAT, mayor de 90 dB y en las áreas restantes fue menor, pero requieren de medidas preventivas ya que todas presentaron 80 un NSCE mayor de dB. En general el nivel de exposición al ruido (NER) de la fábrica es de 86,6 dB, este valor según la normativa aplicada en este estudio es necesario implementar algunas medidas que permitan disminuir los niveles de ruido con la finalidad de evitar enfermedades laborales derivadas del ruido.

Análisis del nivel de ruido, Ruido, Riesgo

7.1 Introduction

The field of occupational health and safety is very broad, ranging from the conditions of facilities and production processes to the behaviour of workers. Work activity is limited by factors capable of causing alterations in the work environment and, therefore, in the worker's health (Alexandry, 1978).

It is important to consider that, for good human performance, the worker must not exceed his or her limits of resistance and remain in adequate conditions in the workplace. One of the main areas of opportunity in occupational hygiene is the study of physical agents such as temperature, lighting, vibrations and the most common of all, noise. Noise has become so common in people's daily lives that we hardly recognise its effects until we have been adversely affected by it.

Noise is defined as an unpleasant and annoying sound. This phenomenon depends on several factors, such as frequency, intensity, duration, exposure time, age of the worker and individual susceptibility.

Noise causes damage to human beings, such as headache, bad mood, insomnia, stress, irritability, central nervous system disorders, hypertension, etc. These affect the quality of life of workers.

The research allowed the evaluation of noise levels in workshops dedicated to the manufacture of decorative resin figures, located in a town in the north of the Municipality of Toluca, capital of the State of Mexico. This study was developed with the objective of having a reference mechanism to prevent health risks derived from the level of exposure to noise generated in this type of installations, so that the owners can protect their personnel by guaranteeing the development of their activities and not be involved in labour lawsuits. The study was limited to the study of only one workshop, which is representative of the activities that are normally carried out in all the workshops located in the area, of which there are more than 50. For the noise level measurements, a CEL Instruments® model CEL-328 type 2 integrating sound level meter was used, and for its calibration, a CEL Instruments® model CEL-282, series 2/11616221 acoustic calibrator was used; the measurements and calibration were carried out taking into account the current legislation on noise in accordance with the Official Mexican Standard NOM-011- STPS-2001, Safety and Hygiene Conditions in Workplaces Where Noise is Generated.

The results obtained from the analysis of the noise level evaluation in the workshop showed that the grinding and music areas had a NSCEAT of 90.1 and 91.7 dB(A) respectively, and the remaining areas had a NSCEAT of 78.8 dB(A), moulding 78. 8 dB(A), casting 81.5 dB(A), finishing 82.4 dB(A), decorating 83.3 dB(A) and compressors 85.4 dB(A), as can be seen the noise level was lower, but it is necessary to take preventive measures since they all gave a NSCEAT greater than 80 dB.

In general the noise exposure level (NER) of the workshop is 86.6 dB, this value according to the standard applied in this study is below 90 dB which is recommended by the regulations that were taken as a reference for an 8-hour working day, but as it resulted in a value greater than 85 dB (A), it is necessary to implement preventive measures to reduce noise levels in order to avoid occupational diseases caused by noise.

7.2 Development

The research carried out is of a cross-sectional type as the study was carried out at a defined time and moment, in this case in an eight-hour working day with three periods of observation or reading, as proposed by the standard, we will also only limit ourselves to observing the events or phenomenon under study without intervening in them, so the research will be non-experimental. Furthermore, the study is descriptive in nature, as it seeks to develop an image or representation of the characteristics of the noise generated by the tools used in this type of workshop, as well as the measurement of the particular variables of this physical phenomenon, for its analysis, emphasising the independent study of each characteristic, but it is possible in some way to integrate the decisions of two or more characteristics in order to determine how the phenomenon is or how it manifests itself.

Thus, at no point is it intended to establish the relationship between these variables. However, the results can be used to predict some phenomenon that can be originated by the studied variable, such as in this case that workers can develop some occupational disease related to high noise levels (Astete and Kitamura, 1978).

North of the city of Toluca there is a population dedicated to the elaboration of resin figures, in which there are approximately 50 workshops dedicated to this activity, directly employing approximately ten people per workshop, and another large number who benefit indirectly from the sale and resale of these articles, making it a very important economic activity in the region, since these pieces are sold all over the country.

Due to the large number of sources of employment that this activity directly generates, it is necessary that it is carried out in such a way that the workers work with safety and hygiene measures that prevent the risks of suffering accidents or occupational diseases (ASIG, 2007) (Atallah, 2007) that could be caused by the processes used in the manufacture of the resin figurines (Figure 7.1).

Figure 7.1 Typical workshop for the manufacture of resin figures in the village of San Andrés Cuexcontitlán

A first effort to determine the health and safety conditions existing in these workshops is to carry out a study of the level of exposure to noise, taking as a reference the regulations in force in Mexico.

For this reason, a tour of the area was carried out in order to obtain authorisation to carry out the study; however, there was very little collaboration from the workshop owners, fortunately one of them agreed to carry out the study.

The workshop where the research was carried out is a typical workshop in the area, since practically all the workshops carry out the same processes and use the same tools and working conditions, so the study is representative of all the other workshops in the area.

In order to carry out the evaluation of the noise level generated in the workshop, a previous visit was made to the workshop to obtain a series of data relating to the production process, such as: the machinery used, the main noise emitting sources figure 7.2, the number of workers exposed and the use of hearing protection equipment.

Figure 7.2 NSCEAT measurement with an integrating sound level meter in the resin pouring area

Once the area to be evaluated had been previously surveyed, the noise exposure level (NER) was determined, for which the following aspects were taken into account.

7.3 Results

The desired confidence level was determined on the basis of the following three considerations:

X= σ or 66% confidence.

X= 2σ or 95% confidence

X= 3σ or 99% confidence
Taking a selection decision of 2σ for this study.

The characteristics of the investigated phenomenon were estimated. For this purpose, the probability of the event occurring (p) or not occurring (q) was determined; when insufficient information is available on the probability of the event, it is assigned the maximum values:

P=0.50 q=0.50

The maximum acceptable degree of error in the research results was determined. This can be up to 10%; normally the most advisable is to work with variables of 2 to 6%, as variations of more than 10% reduce the validity of the information too much.

The finite sample size formula is applied when it is known how many elements the population has (Branco, 2007) (Campanhole 1993).

For finite populations the sample is:

$$n = \frac{Z^2pqN}{Ne^2+Z^2pq} \quad (1)$$

Where:

Z=confidence level; (95%-5%).

N=universe; 50

P=probability in favour;(0.50)

q=probability against;(0.50)

e=estimation error; 5%.

n=sample size

$$n = \frac{1.96^2 * (1-0.5) * 0.5 * 50}{50 * (0.05)^2 + (1.96)^2(1-0.5) * 0.5}$$

$$n = \frac{48.02}{0.125 + 0.9604} = \frac{48.02}{1.0854} = 44.24$$

Therefore the sample size is 44 workshops, but as mentioned above it was difficult to convince the owners of these to agree to carry out the study, therefore it is recommended for further research on the topic to expand the sample size, however for our study we selected a non-probabilistic sample selection method, This is the case of decisional sampling, which is characterised by the fact that the field researcher uses his or her criteria to select the elements of the sample based on a clear definition of the target population, as in this case study, so a representative workshop was selected from the 50 workshops that work in the area (Munch, 2005).

These workshops are mainly micro-enterprises in which approximately 15 people work in each workshop in which the owners of the workshop constitute a third of the total workforce, the family employees are mainly made up of the parents and three children, who carry out all the business administration from the purchase of raw materials to the sale of the product.

From the processes used in this type of workshop it could be observed that there are multiple hygienic risks (Cavani, 2003) (Clemente, 1991) such as the use of dangerous substances like toluene, oil paints, large quantities of resin dust, noise, vibrations, handling of loads, etc.

The hygienic risk that motivated this research was the noise generated by a pneumatic polisher, compression equipment, blowing parts, airbrushes and the excessive volume of the music that workers usually listen to during their work, so that this physical agent can put them at risk of suffering an occupational disease and affect their health.

Firstly, a sensory survey was carried out to determine the type of noise produced, resulting in an unstable noise, since the maximum and minimum readings recorded by the sound level meter were higher than the 5 dB recommended by NOM-011-STPS-2011 (Corrales, 2009).

To determine the noise exposure level (NER), the workshop was divided into eight areas, which are also the number of processes used, in order to determine the NSCEAT of each workstation and subsequently determine the NER of the workshop, giving the following results.

Reliability of the measuring instrument

In order to be certain of the determination of the NER, the type 2 integrating sound level meter was sent for calibration to the company Asesoría y Servicios Integrales en Calibración, S.C. (ASIC). (ASIC), which shows the certificate of accreditation of the sound level meter, where the data of the calibration laboratory are presented, such as: name, denomination or company name of the verification unit, approval number granted by the Ministry of Labour and Social Welfare, code and name of the standard verified, result of the verification, name and signature of the authorised representative, place and date of the issuance of the report, validity of the report.

Field calibration, as established in the standard, is carried out before and after obtaining the noise levels, in order to corroborate that there is no de-calibration in the sound level meter and to be able to validate the readings taken.

The calibration was carried out at a level of 114 dB, with a CEL Instruments Ltd® brand calibrator, model CEL-282, series 2/11616221. This resulted in a difference of 0 dB, which validates the measurements taken on that day according to the Mexican standard applied, obtaining the following results as shown below:

Resin casting area

Figure 7.3 NSCEAT measurement with an integrating sound level meter in the resin pouring area

Figure 7.4 Graph of noise behaviour in the casting area

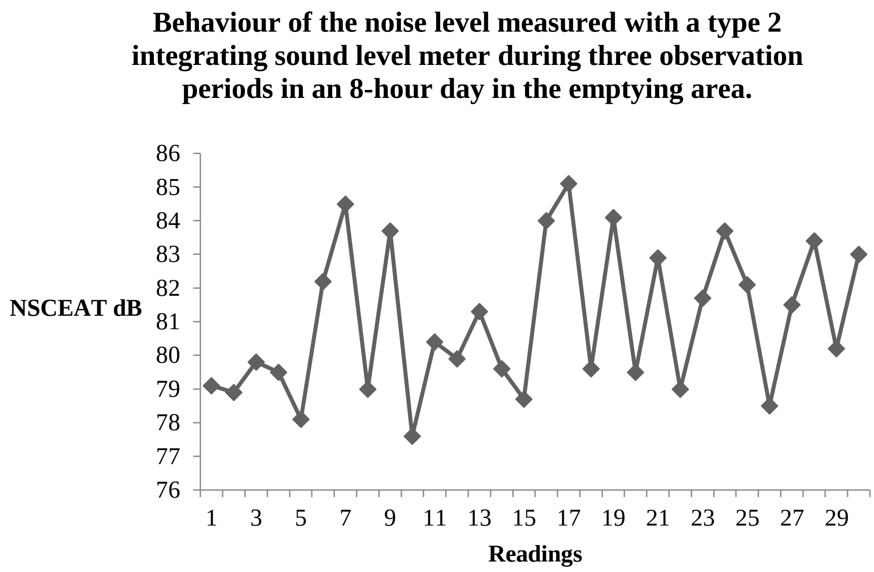


Table 7.1 Recording of 3 observation periods during an 8-hour working day of the noise level with a type 2 integrating sound level meter in the resin casting area

Reading	Noise level dB(A)	Time (s)
First period		
1	79.1	0
2	78.9	30
3	79.8	60
4	79.5	90
5	78.1	120
6	82.2	150
7	84.5	180
8	79.0	210
9	83.7	240
10	77.6	270
Second period		
11	80.4	0
12	79.9	30
13	81.3	60
14	79.6	90
15	78.7	120
16	84.0	150
17	85.1	180
18	79.6	210
19	84.1	240
20	79.5	270
Third period		
21	82.9	0
22	79.0	30
23	81.7	60
24	83.7	90
25	82.1	120
26	78.5	150
27	81.5	180
28	83.4	210
29	80.2	240
30	83.0	270
NSCEATi = 81.5 dB(A)		

Development of the equation for the calculation of the NSCEAT for unsteady noise in the casting area.

$$NSCE_{A,T}i = 10log\frac{1}{30}\left[\left(10^{\frac{79.1}{10}}\right) + \left(10^{\frac{78.9}{10}}\right) + \left(10^{\frac{79.8}{10}}\right) + \left(10^{\frac{79.5}{10}}\right) + \left(10^{\frac{78.1}{10}}\right) + \left(10^{\frac{82.2}{10}}\right) + \left(10^{\frac{84.5}{10}}\right) + \left(10^{\frac{79}{10}}\right) + \left(10^{\frac{83.7}{10}}\right) + \left(10^{\frac{77.6}{10}}\right) + \left(10^{\frac{80.4}{10}}\right) + \left(10^{\frac{79.9}{10}}\right) + \left(10^{\frac{81.3}{10}}\right) + \left(10^{\frac{79.6}{10}}\right) + \left(10^{\frac{78.7}{10}}\right) + \left(10^{\frac{84}{10}}\right) + \left(10^{\frac{85.1}{10}}\right) + \left(10^{\frac{79.6}{10}}\right) + \left(10^{\frac{84.16}{10}}\right) + \left(10^{\frac{79.5}{10}}\right) + \left(10^{\frac{82.9}{10}}\right) + \left(10^{\frac{79}{10}}\right) + \left(10^{\frac{81.7}{10}}\right) + \left(10^{\frac{83.7}{10}}\right) + \left(10^{\frac{82.1}{10}}\right) + \left(10^{\frac{78.5}{10}}\right) + \left(10^{\frac{81.5}{10}}\right) + \left(10^{\frac{83.4}{10}}\right) + \left(10^{\frac{80.2}{10}}\right) + \left(10^{\frac{83}{10}}\right)\right]\text{=81.5 dB(A)}$$

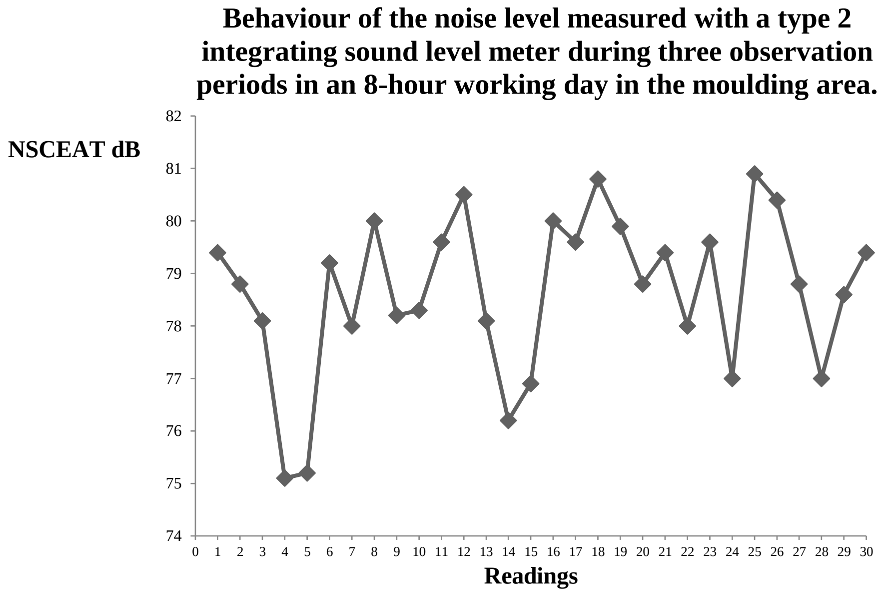
Moulding area

Figure 7.5 NSCEAT measurement with integrating sound level meter type 2, in the moulding area

Table 7.2 Recording of 3 observation periods during an 8-hour working day of the noise level with a type 2 integrating sound level meter in the moulding area

Reading	Noise level dB(A)	Time (s)
First period		
1	79.4	0
2	78.8	30
3	78.1	60
4	75.1	90
5	75.2	120
6	79.2	150
7	78.0	180
8	80.0	210
9	78.2	240
10	78.3	270
Second period		
11	79.6	0
12	80.5	30
13	78.1	60
14	76.2	90
15	76.9	120
16	80.0	150
17	79.6	180
18	80.8	210
19	79.9	240
20	78.8	270
	Third period	
21	79.4	0
22	78.0	30
23	79.6	60
24	77.0	90
25	80.9	120
26	80.4	150
27	78.8	180
28	77.0	210
29	78.6	240
30	79.4	270
	NSCEATi = 78.8 dB(A)	

Figure 7.6 Noise behaviour graph in the moulding area



Development of the equation for the calculation of the NSCEAT for unsteady noise in the moulding area.

$$NSCE_{A,T}i = 10log\frac{1}{30}\left[\left(10^{\frac{79.4}{10}}\right)+\left(10^{\frac{78.8}{10}}\right)+\left(10^{\frac{78.1}{10}}\right)+\left(10^{\frac{75.1}{10}}\right)+\left(10^{\frac{75.2}{10}}\right)+\left(10^{\frac{79.2}{10}}\right)+\left(10^{\frac{78}{10}}\right)+\left(10^{\frac{80}{10}}\right)+\left(10^{\frac{78.2}{10}}\right)+\left(10^{\frac{78.3}{10}}\right)+\left(10^{\frac{79.6}{10}}\right)+\left(10^{\frac{80.5}{10}}\right)+\left(10^{\frac{78.1}{10}}\right)+\left(10^{\frac{76.2}{10}}\right)+\left(10^{\frac{76.9}{10}}\right)+\left(10^{\frac{80}{10}}\right)+\left(10^{\frac{79.6}{10}}\right)+\left(10^{\frac{80.8}{10}}\right)+\left(10^{\frac{79.9}{10}}\right)+\left(10^{\frac{78.8}{10}}\right)+\left(10^{\frac{79.4}{10}}\right)+\left(10^{\frac{78}{10}}\right)+\left(10^{\frac{79.6}{10}}\right)+\left(10^{\frac{77}{10}}\right)+\left(10^{\frac{80.9}{10}}\right)+\left(10^{\frac{80.4}{10}}\right)+\left(10^{\frac{78.8}{10}}\right)+\left(10^{\frac{77}{10}}\right)+\left(10^{\frac{78.6}{10}}\right)+\left(10^{\frac{79.4}{10}}\right)\right] = 78.8 \text{ dB(A)}$$

Patching area

Figure 7.7 NSCEAT measurement with type 2 integrating sound level meter, in the patching area

Figure 7.8 Graph of noise behaviour in the patching area

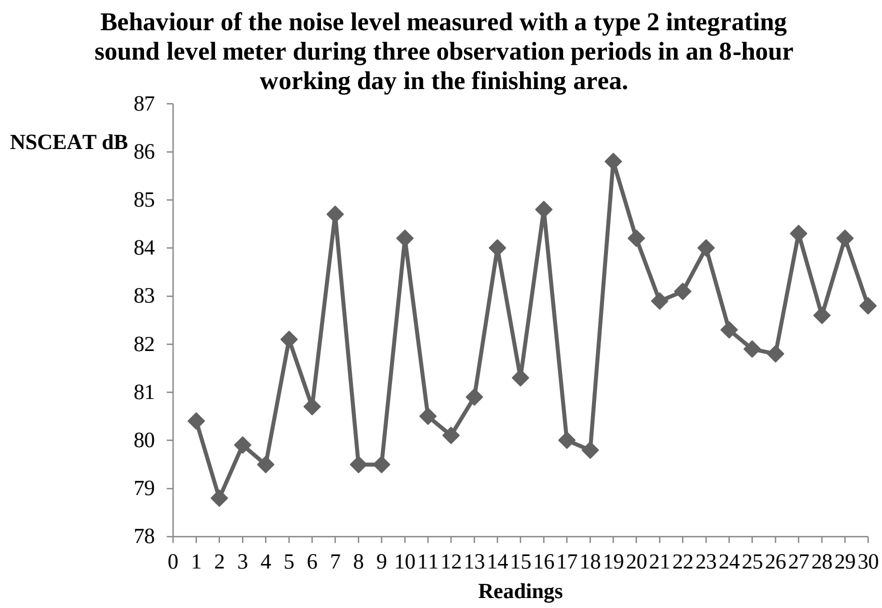


Table 7.3 Recording of the 3 observation periods during an 8 h working day of the noise level with a type 2 integrating sound level meter in the area of the finishing area

Reading	Noise level dB(A)	Time (s)
First period		
1	80.4	0
2	78.8	30
3	79.9	60
4	79.5	90
5	82.1	120
6	80.7	150
7	84.7	180
8	79.5	210
9	79.5	240
10	84.2	270
Second period		
11	80.5	0
12	80.1	30
13	80.9	60
14	84.0	90
15	81.3	120
16	84.8	150
17	80.0	180
18	79.8	210
19	85.8	240
20	84.2	270
	Third period	
21	82.9	0
22	83.1	30
23	84.0	60
24	82.3	90
25	81.9	120
26	81.8	150
27	84.3	180
28	82.6	210
29	84.2	240
30	82.8	270
	NSCEATi = 82.4 dB(A)	

Development of the equation for the calculation of the NSCEAT for unsteady noise in the patching area.

$$NSCE_{A,T}i = 10log\frac{1}{30}\Big[\left(10^{\frac{80.4}{10}}\right)+\left(10^{\frac{78.8}{10}}\right)+\left(10^{\frac{79.9}{10}}\right)+\left(10^{\frac{79.5}{10}}\right)+\left(10^{\frac{82.1}{10}}\right)+\left(10^{\frac{80.7}{10}}\right)+\left(10^{\frac{84.7}{10}}\right)+\left(10^{\frac{79.5}{10}}\right)+\left(10^{\frac{79.5}{10}}\right)+\left(10^{\frac{84.2}{10}}\right)+\left(10^{\frac{80.5}{10}}\right)+\left(10^{\frac{80.1}{10}}\right)+\left(10^{\frac{80.9}{10}}\right)+\left(10^{\frac{84}{10}}\right)+\left(10^{\frac{81.3}{10}}\right)+\left(10^{\frac{84.8}{10}}\right)+\left(10^{\frac{80}{10}}\right)+\left(10^{\frac{79.5}{10}}\right)+\left(10^{\frac{85.8}{10}}\right)+\left(10^{\frac{84.2}{10}}\right)+\left(10^{\frac{82.9}{10}}\right)+\left(10^{\frac{83.1}{10}}\right)+\left(10^{\frac{84}{10}}\right)+\left(10^{\frac{82.3}{10}}\right)+\left(10^{\frac{81.9}{10}}\right)+\left(10^{\frac{81.7}{10}}\right)+\left(10^{\frac{84.3}{10}}\right)+\left(10^{\frac{82.6}{10}}\right)+\left(10^{\frac{84.2}{10}}\right)+\left(10^{\frac{82.8}{10}}\right)\Big] = 82.4 \text{ dB(A)}$$

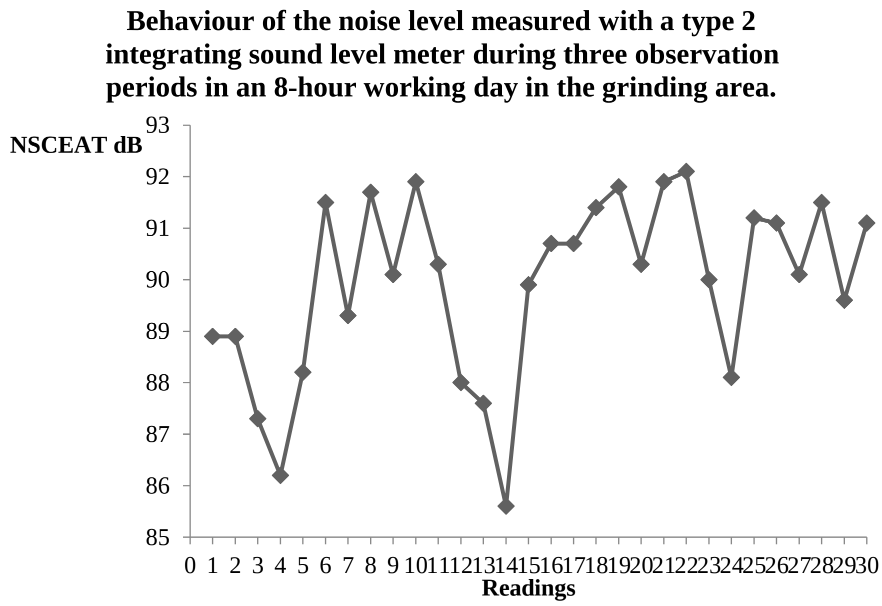
Grinding area

Figure 7.9 NSCEAT measurement with integrating sound level meter type 2, in the grinding area

Table 7.4 Recording of 3 observation periods during an 8-hour working day of the noise level with a type 2 integrating sound level meter in the grinding area

Reading	Noise level (dB(A)	Time (s)
First period		
1	88.9	0
2	88.9	30
3	87.3	60
4	86.2	90
5	88.2	120
6	91.5	150
7	89.3	180
8	91.7	210
9	90.1	240
10	91.9	270
Second period		
11	90.3	0
12	88.0	30
13	87.6	60
14	85.6	90
15	89.9	120
16	90.7	150
17	90.7	180
18	91.4	210
19	91.8	240
20	90.3	270
	Third period	
21	91.9	0
22	92.1	30
23	90.0	60
24	88.1	90
25	91.2	120
26	91.1	150
27	90.1	180
28	91.5	210
29	89.6	240
30	91.1	270
	NSCEATi = 90.1 dB(A)	

Figure 7.10 Graph of noise behaviour in the grinding area



Development of the equation for the calculation of the NSCEAT for unsteady noise in the grinding area.

$$NSCE_{A,T}i = 10log\frac{1}{30}\Big[\Big(10^{\frac{88.9}{10}}\Big)+\Big(10^{\frac{88.9}{10}}\Big)+\Big(10^{\frac{87.3}{10}}\Big)+\Big(10^{\frac{86.2}{10}}\Big)+\Big(10^{\frac{88.2}{10}}\Big)+\Big(10^{\frac{91.5}{10}}\Big)+\Big(10^{\frac{89.3}{10}}\Big)+\Big(10^{\frac{91.7}{10}}\Big)+\Big(10^{\frac{90.1}{10}}\Big)$$
$$+\Big(10^{\frac{91.9}{10}}\Big)+\Big(10^{\frac{89.3}{10}}\Big)+\Big(10^{\frac{88}{10}}\Big)+\Big(10^{\frac{87.6}{10}}\Big)+\Big(10^{\frac{85.6}{10}}\Big)+\Big(10^{\frac{89.9}{10}}\Big)+\Big(10^{\frac{90.7}{10}}\Big)+\Big(10^{\frac{90.7}{10}}\Big)+\Big(10^{\frac{91.4}{10}}\Big)+\Big(10^{\frac{91.8}{10}}\Big)$$
$$+\Big(10^{\frac{90.3}{10}}\Big)\Big(10^{\frac{91.9}{10}}\Big)+\Big(10^{\frac{92.1}{10}}\Big)+\Big(10^{\frac{90}{10}}\Big)+\Big(10^{\frac{88.1}{10}}\Big)+\Big(10^{\frac{91.2}{10}}\Big)+\Big(10^{\frac{91.1}{10}}\Big)+\Big(10^{\frac{90.1}{10}}\Big)+\Big(10^{\frac{91.5}{10}}\Big)+\Big(10^{\frac{89.6}{10}}\Big)$$
$$+\Big(10^{\frac{91.1}{10}}\Big)\Big] = 90.1dB(A)$$

Decoration area - 1

Figure 7.11 NSCEAT measurement with integrating sound level meter type 2, in the set-1 area

Figure 7.12 Graph of noise behaviour in set area-1

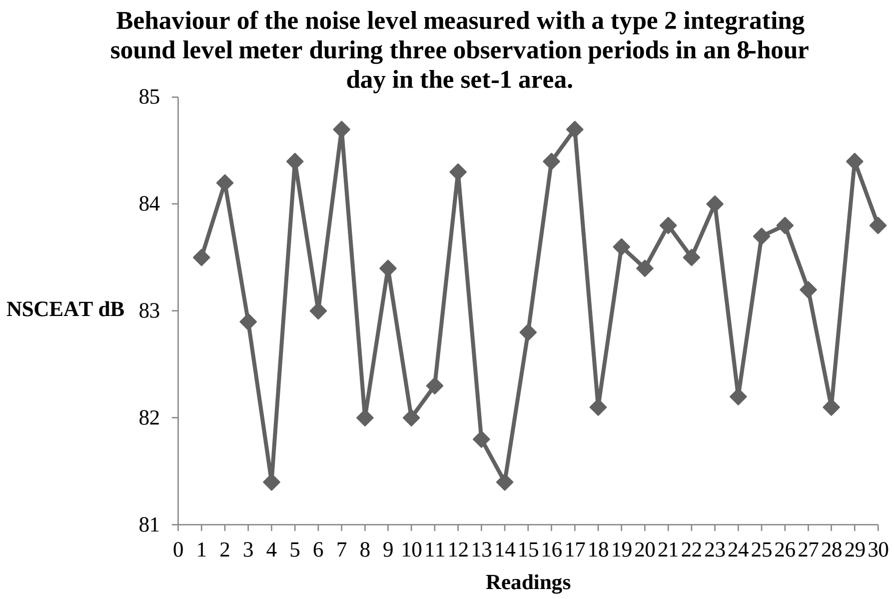


Table 7.5 Recording of the 3 observation periods during an 8 h working day of the noise level with type 2 integrating sound level meter in the set-1 area

Reading	Noise level (dB)	Time (s)
First period		
1	83.5	0
2	84.2	30
3	82.9	60
4	81.4	90
5	84.4	120
6	83.0	150
7	84.7	180
8	82.0	210
9	83.4	240
10	82.0	270
Second period		
11	82.3	0
12	84.3	30
13	81.8	60
14	81.4	90
15	82.8	120
16	84.4	150
17	84.7	180
18	82.1	210
19	83.6	240
20	83.4	270
	Third period	
21	83.8	0
22	83.5	30
23	84.0	60
24	82.2	90
25	83.7	120
26	83.8	150
27	83.2	180
28	82.1	210
29	84.4	240
30	83.8	270
	NSCEATi = 83.3 dB(A)	

Development of the equation for the calculation of the NSCEAT for unsteady noise in the set-1 area.

$$NSCE_{A,T}i = 10log\frac{1}{30}\left[\left(10^{\frac{83.5}{10}}\right) + \left(10^{\frac{84.2}{10}}\right) + \left(10^{\frac{82.9}{10}}\right) + \left(10^{\frac{81.4}{10}}\right) + \left(10^{\frac{84.4}{10}}\right) + \left(10^{\frac{83.0}{10}}\right) + \left(10^{\frac{84.7}{10}}\right) + \left(10^{\frac{82.0}{10}}\right) + \left(10^{\frac{83.4}{10}}\right) + \left(10^{\frac{82.0}{10}}\right) + \left(10^{\frac{82.3}{10}}\right) + \left(10^{\frac{84.3}{10}}\right) + \left(10^{\frac{81.8}{10}}\right) + \left(10^{\frac{81.4}{10}}\right) + \left(10^{\frac{82.8}{10}}\right) + \left(10^{\frac{84.4}{10}}\right) + \left(10^{\frac{84.7}{10}}\right) + \left(10^{\frac{82.1}{10}}\right) + \left(10^{\frac{83.6}{10}}\right) + \left(10^{\frac{83.4}{10}}\right) + \left(10^{\frac{83.8}{10}}\right) + \left(10^{\frac{83.5}{10}}\right) + \left(10^{\frac{84}{10}}\right) + \left(10^{\frac{82.2}{10}}\right) + \left(10^{\frac{83.7}{10}}\right) + \left(10^{\frac{83.8}{10}}\right) + \left(10^{\frac{83.2}{10}}\right) + \left(10^{\frac{82.1}{10}}\right) + \left(10^{\frac{84.4}{10}}\right) + \left(10^{\frac{83.8}{10}}\right)\right] = 83.33 \text{ dB(A)}$$

7.4 Conclusions

Once the methodology for the evaluation of the level of exposure to noise (NER) had been developed and the analysis of the measurements taken in the resin figure workshop of the different workstations in the workshop had been completed, the following conclusions could be drawn:

The analysis of the information collected in the workshop and the evaluation using the method proposed by the NOM-011-STPS-2001, made it possible to obtain information in a simple way on the activities and characteristics of the workstation, in order to evaluate the levels of exposure to noise.

The method followed made it possible to evaluate the workstations in the time allotted for the inspection of the workshop, thus providing valuable information to detect critical areas and guide preventive measures for noise exposure.

Nevertheless, based on a limited sample of workshops, the present study was able to detect some of the most important shortcomings of this craft activity in this area. It was found, for example, the existence of NSCEAT levels that exceed the norm and there is no control over them, which results in significant damage to the health of workers who are often unaware of the situation due to lack of evaluations, examinations and training by the workshop owners.

The analysis of the noise level generated in the workshop dedicated to the elaboration of resin figures concludes that the maximum NSCEAT obtained are in the grinding areas, caused by the use of a manual pneumatic grinding machine that generates a NSCEAT of 90.1 dB(A). In this area only one worker works, the other critical area is the area where the sound equipment or background music is located which generates a NSCEAT of 91.7 dB(A), consequently, this level also affects workers who are close to this equipment such as the decoration area one and two, in addition to the grinding and resurfacing areas where 10 workers work (CANAMA, 2013).

In general the noise exposure level of the workshop (NER) was 86.6 dB(A), which is below the maximum level of 90 dB recommended by the standard for an 8-hour working day, so in general there is no danger of suffering any occupational disease caused by noise, but as the level is above 85 dB the standard recommends that preventive measures be taken to avoid the risk of suffering any disease resulting from exposure to noise.

Therefore, this result obtained in the present study demonstrates that the noise conditions to which the workshop workers are exposed do not represent any risk for the workers.

By virtue of this research, the following recommendations are suggested for the improvement of the working conditions of workers in this type of workshop.

There are areas where the value is greater than 90 dB, establishing that the personnel working in these areas strictly comply with NOM-011-STPS-2001.

Establish a programme every six months for the medical examination of workshop workers, to identify cases of hearing loss in time, as a preventive measure.

In coordination with the owner, establish a programme for the rotation of the most exposed personnel, such as grinding workers, so that exposure time is within safe limits.

Delimit the areas of those areas where noise is generated in order to avoid damaging neighbouring areas that do not have this problem.

Ensure that workers exposed in noisy areas are duly monitored periodically, in order to establish follow-up and control, detecting cases of diminished capacity in a timely manner.

Carry out audiometric examinations to detect diminished capacity in workers in a timely manner in order to establish action plans.

Develop awareness-raising talks, highlighting the effects that prolonged exposure to noise can have on workers, reinforcing the use of hearing protection equipment.

Provide workers with personal protective equipment (PPE), ensuring that it is appropriate for the type and time of exposure to noise.

Build compressor sheds with sound-absorbing walls and ceilings.

Restrict the presence of workers to an adequate distance from noisy equipment.

Evaluate the attenuation of hearing protectors and effectiveness for noise in the specific job.

7.5 References

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