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## Halı İşletmelerindeki Gürültü Maruziyetinin İncelenmesi

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***Araştırma Makalesi / Research Article***

# INVESTIGATION OF NOISE EXPOSURE IN CARPET FACTORIES

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**ABSTRACT:** The carpet weaving industry is an important sector all over the world and there are no regulations about the noise of carpet weaving machines. Noise can cause a type of occupational disease if necessary, precautions are not taken. If the sound of the machine is not changed, the place of noisy machines can be changed in the mill to decrease the risk of danger originated by noise. In this study, 5 different carpet mills in Gaziantep, Türkiye were selected to detect the noise level randomly. The data were collected by using a noise measurement device positioned at a 1 m distance from the noise source. The measured values are compared to accepted values and necessary relocations of machines were made. In accordance with the noise-ambient measurement results weaving, carpet back coating, engraving, automation machines, and pneumatic table are found as noisy machines. Within these machines, engraving and weaving machines are the noisiest ones and there is a risk for the operators of engraving and weaving machines. At the end of the study, some suggestions to minimize the noise were given to the factories.

**Keywords:** Occupational accidents, noise, a carpet factory, safety.

# HALI İŞLETMELERİNDEKİ GÜRÜLTÜ MARUZİYETİNİN İNCELENMESİ

**ÖZET** Halı dokuma sektörü tüm dünyada önemli bir sektördür ve halı dokuma makinelerinin gürültüsü ile ilgili herhangi bir düzenleme bulunmamaktadır. Gürültü önlem alınmazsa bir tür meslek hastalığına neden olabilir,. Makinenin sesi değiştirilemediğinden, gürültüden kaynaklanan tehlike riskini azaltmak için gürültülü makinelerin yerleri değiştirilebilir. Bu çalışmada, gürültü seviyesini tespit etmek için Gaziantep'deki 5 farklı halı fabrikası rastgele seçilmiştir. Veriler, gürültü kaynağından 1 m mesafeye yerleştirilmiş bir gürültü ölçüm cihazı kullanılarak toplanmıştır. Ölçülen değerler kabul edilen değerlerle karşılaştırılarak gerekli makina yer değiştirmeleri yapılmıştır. Gürültü-ortam ölçüm sonuçlarına göre dokuma, halı arka kaplama, oyma, otomasyon makineleri ve pnömatik tabla gürültülü makineler olarak bulunmuştur. Bu makineler içinde gravür ve dokuma makineleri en gürültülü olanlardır ve gravür ve dokuma makinesi operatörleri için risk vardır. Çalışmanın sonunda fabrikalara gürültünün en aza indirilmesi için bazı önerilerde bulunulmuştur.

**Anahtar kelimeler:** Meslek hastalıkları, gürültü, halı fabrikası, güvenlik.

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## 1. INTRODUCTION

Occupational accidents and occupational diseases are the two biggest problems of work life. Although notice inadequacy and informality are at high levels; according to International Labor Organization's (ILO) data, it is determined that millions of people having occupational accidents, and millions of people lost their lives due to occupational accidents and diseases [1]. These data indicate that occupational health and safety are some of the most important factors in working life.

Similarly, according to the 2016 data of Social Security Institution (SGK), there are 1.749.240 registered workplaces and 13.775.188 registered employees in Turkey. In those registered workplaces, 48.796 (2,8%) workplaces are composed of sectors that belong to Textile Manufacturing and Readymade Manufacturing, and the 875.383 (6,35%) of total registered employees are employed in those sectors [1]. As it is understood from those data, the textile sector has an important role in terms of the employment population. And this makes the textile sector one of the most important sectors in terms of occupational health and safety for our country.

When we analyze occupational accidents and occupational diseases in terms of textile sector; it is indicated that 17.550 occupational accidents and 8 occupational diseases happened in textile sector in 2016 data of Social Security Institution [1]. These accidents that happen in our country and in the World are leading to severe loss in terms of employer and country economy apart from the damages up to human health and losing one's life [2]. Given the economic aspect of these statistics, it is anticipated that in developing countries the cost of occupational accidents and occupational diseases will increase to 4% of Gross Domestic Product (GSYIH) [1]. According to the 2016 data of TUIK; the cost of occupational accidents and occupational diseases is approximately 100 billion Turkish liras [1]. These data show that; occupational health and safety practices are very important in the national economy. Some laws have been enacted to eliminate these problems in business life in our country. The results of statistics, which were committed by the International Labor Organization in 199 countries, are seen on Figure 1 and Figure 2.


**Figure 1.** Reasons of occupational accidents [3]

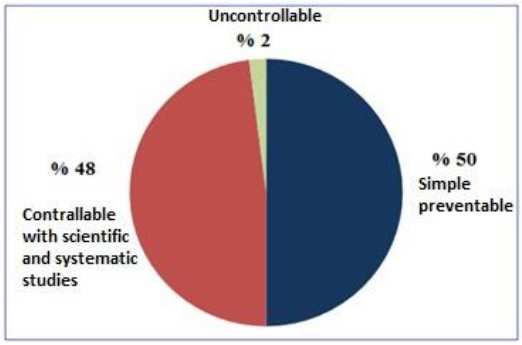


**Figure 2.** Statistics of occupational accidents' preventability [3]

**The textile industry** has a lot of risks and dangers in terms of occupational health and safety. These are dangers originating from powders, dangers originating from work equipment and moving parts, dangers originating from work process and non-ergonomic working conditions, fire, chemicals, and noise.

The most important raw material of the textile sector is fiber. Because fiber is an easily burning substance, the fire factor is very important. There are many areas where chemicals are used in the textile industry. Exposure to chemicals must be observed when working with chemicals. In the textile sector because of working with dust, there are occupational diseases related to the respiratory tract, especially jean sandblasting workplaces. According to 2016 data of SSI; 216 workers have got an occupational disease in respiratory in Turkey [2]. The textile industry is a sector where there is a lot of work with machinery, so the risks of moving parts of machinery are very high. It is also a sector when manpower is overused in the textile sector. Special attention should therefore be paid to ergonomic factors. Laws and regulations have been enacted to prevent all these risks and dangers in Turkey.

**Noise**, which is identified as disturbing or unwanted sound, constitutes being an important environmental problem that affects human health and life quality in countries in which industrialization and urbanization are experienced extremely. To International Labor Organization (ILO) identifies noise as all of the sounds which cause hearing loss, which are dangerous for the health, and which reveal other dangers **[1].** For a better understanding of noise, the following definitions should be well known [1]. These ones; noise level, decibel, dB(A), dB(C), Peak. $L_{eq.}$ $L_{EX,\ 8hours}$. Also, the noise levels in working life are determined by national and international regulations [4].

***National Legislations;*** The name of the regulation is "Regulation about Employees Protection from Risks about Noise" Exposition Action Values, Exposition Limit Values are shown in Table 1.

The number of employees, who got occupational diseases originated from noise according to 2016 data of Social Security Institution in Turkey is totally 6 as only male.

Exposition and obligation periods in noisy works according to "Social Security Health Procedures Rule"; In order to evaluate

noise damages as occupational diseases, the employee should work at noisy works at least two years, and he/ she should work at works, whose noise level is continuously more than 85 decibel, at least 30 days. The obligation period is stated as 6 months. International legislations; daily noise exposition limit values, which are specified by international institutes, are given in Table 2.

The values, belonging to the relation between noise level and working duration according to ILO's standards, are expressed on Table 3. Given values are valid in the situations if noise is continuous or discontinuous. It is not applied on explosion and pulsed noises.

Noise is an important parameter in terms of occupational health and safety especially in workplaces in which noisy as knitting, yarn spinning, weaving machines work in textile sector. Therefore, checking the noise exposition level of employees, working at this kind of workplace, is so significant. When the noise levels of some textile business in Table 4 is examined, it is determined that especially weaving and yarn twisting departments' exposition limit values are much more than the regulations specify and it constitutes risk.

**Table 1.** Exposition action and limit values stated in the regulation on works with noise **[1]**

| | | | | |
|---|---|---|---|---|
| **Regulations Related to Employees' Protection From the Risk About Noise** | **Lowest Exposition Action Values** | 80 dB(A) | 135 dB (C) | 112 Pa |
| | **Upper Exposition Action Values** | 85 dB(A) | 137 dB(C) | 140 Pa |
| | **Exposition Limit Values** | 87 dB(A) | 140 dB (C) | 200 Pa |

**Table 2.** Noise Exposition Limit Values in International Regulations [1,6,7]

| | | | |
|---|---|---|---|
| **England Occupational Health and Security Organization (HSE)** | Lowest Exposition Action Values | **80 dB(A)** | 135 dB(C) |
| | Upper Exposition Action Values | **85 dB(A)** | 137 dB(C) |
| | 8 Hours Exposition Limit Values | **87 dB(A)** | 140 dB(C) |
| **Occupational Health and Safety Organization of America (OSHA)** | 8 Hours Exposition Value | **90 dB(A)** | - |
| **American National Institute of Occupational Health and Safety (NIOSH)** | 8 Hours Exposition Value | **85 dB(A)** | - |
| **Canada Centre of Occupational Health and Safety (CCOHS)** | 8 Hours Exposition Value | **87 dB(A)** | - |

**Table 3.** Maximum working hours related to noise level [1]

| **Maximum Noise Level dB(A)** | **Exposition Period of Noise (hour/day)** | **Maximum Noise Level dB(A)** | **Exposition Period of Noise (hour/day)** |
|---|---|---|---|
| 80 | 16 | 100 | 1 |
| 85 | 8 | 105 | ½ |
| 90 | 4 | 110 | ¼ |
| 95 | 2 | 115 | 1/8 |

**Table 4.** Noise levels of textile departments of fabrics **[5]**

| **Department** | **Noise Level** | **Department** | **Noise Level** |
|---|---|---|---|
| Blow room – Carding- Draw Frame – Combed | 80-85 dB(A) | Knitting | 80-85 dB(A) |
| Roving Frame - Ring Spinning Yarn | 85-93 dB(A) | Weaving | 93-100 dB(A) |
| Weaving preparatory, Sizing and Weaving Draft | 80-85 dB(A) | Fabric painting | 80-85 dB(A) |
| Yarn Twist – doubling | 95-105 dB(A) | Fabric dyeing | 80-85 dB(A) |

Table 4 shows that weaving, yarn twisting – doubling, and roving-ring departments are the highest noisy parts in the textile sector. Therefore, it is decided that these departments are the most important areas in terms of noise check and working employee sensitivity.

In the literature there are interesting studies about occupational diseases and accidents. In a study, the effects of noise on performance were investigated. As a result of the measures taken with noise, it has been determined that there are positive developments in the performances of the employees [8]. Oil refineries also have very noisy working environments. In particular, it has been found that some processes have a noisy working environment of more than 90 dB (A). As a result of the investigations, he stated that hearing problems are caused by a large amount of noise exposure and also by the age of employees [9]. In another study conducted in textile enterprises, especially in the weaving and yarn noise level is high, especially in the weaving section of the working hours of 8 hours over 90 dB (A) has been determined to work [10]. Again, in order to reduce noise levels in textile plants, a study was conducted. As a result of the study, it has been determined that the most effective way to reduce the noise level is to isolate the machines and to install the noise reduction equipment on the air conditioning and ventilation equipment and the method called protective coating method [11]. Studies done about the noise in flour, oil and feed enterprises are as the following: flour enterprises, not working more than 4 hours in mill, sifting and cleaning sections, in the separation section should not work for more than 7.5 hours, feed business in the negative impact will not have a negative impact on human health, oil in the crushing - grinding and screening in the areas of the noise level in the cleaning section exceeds the limit value, crushing - grinding sections in the elimination - cleaning sections of more than 2 hours while it should not be worked for more than 4 hours [12]. In the wood carpentry workshop, the noise level is above 87 dB (A) on average and working time should not be more than 7.5 hours [13]. In another study, the noise was found to cause occupational accidents, occupational disease, and poor performance. The most important risk was found to be hearing loss. It was determined that 80% of the measurements made a significant amount of noise exposure [14]. In another study, noise measurements were made in fabric, towel, and carpet weaving mills. The average amount of personal noise exposure in fabric and towel weaving mills was found to be 94.03 dB (A) and the personal noise exposure in carpet weaving plants was 86.6 dB (A). When these values were evaluated together with the operating height and the distances between the machines, the noise exposure decreased as the height and distance increased [15].

This paper it is aimed to investigate the noise exposures in carpet factories and to find out alternative ways to decrease the effect of this noise on the workers.

## 2. MATERIAL AND METHOD

### 2.1. Material

In this study, Gaziantep is preferred for the measurements because according to the amount of carpet production in Turkey, Gaziantep has the highest ratio. The pieces of carpet weaving factories operating in the Gaziantep Organize Industrial Zone were selected as a material to make noise measurements at carpet companies in the textile sector. Generally, those factories are similar but as seen in Table 5 number of carpet weaving machines, processes, the number of employees has different qualities in terms of capacity.

**Table 5.** Some properties about measured factories

| Qualification of factories | Factory 1 | Factory 2 | Factory 3 | Factory 4 | Factory 5 |
|---|---|---|---|---|---|
| Number of weaving Machines | 3 | 18 | 15 | 11 | 8 |
| Number of workers | 67 | 600 | 251 | 200 | 150 |
| Capacity ($m^2$/month) | 55000 | 250000 | 170000 | 120000 | 90000 |

The companies which make noise measurements have similarities in the shape of process and good production. The differences between companies are at the point of self-producing carpet yarn, application of different techniques to design (give pattern) after carpet producing or apparel department. The measurement in factories, to measure of noise level which occurred in the working environment of employees, a measure of individual exposures timing from the noise made by bearing in mind that appropriate measure standard method. The aim here is to determine the ambient noise and at the same time, the level of exposure to noise level then reveal the differences between those two-text values.

All the measuring techniques and instruments are selected in accordance with international standards. For individual daily noise exposure, “ISO 9612:2009 Acoustics -- Determination of occupational noise exposure – Engineering method” used method for preparing appropriate standards. Measurement is made by a noise measurement device is positioned at a 1-meter distance from the noise source. The measured values are compared with 85 dB(A) which is the accepted upper action value and 87 dB(A) which is the accepted exposition limit value in our country and international standards and noisy environment and individual noise exposure situation of carpet weaving factories are evaluated with separate graphics and tables.

### 2.2.Method

The noise measuring device used to measure the noise level of the environment is Cesva/SC310. It can be expanded according to the 1/3 octave band spectrum analyzer. The device contains all the functions necessary for calculating the basic indices for the acoustic evaluation of many countries in the world, such as equivalent levels, percent, peak levels and sound exposure levels [16]. After each measurement, the device is calibrated with CESVA/CB006 in the laboratory or at the measurement site.

The measuring device used for personal exposure is the QUEST 3M/ EDGE 5 model. It is made of lithium polymer material and is a premium device. IEC 61252 approved and ANSI S1. It

complies with 25 and CE standards. It is used in a way that does not disturb the worker [17]. The calibrator device used for the accuracy of the measuring device in the field is the QUEST 3M/ QC 20 model. It can measure faster and more sensitively than other calibrators. It has the ability to produce a constant sound level of 114 dB at a constant frequency of 1000 Hz. The calibrator is IEC and ANSI approved [18].


**Figure 3.** Environment noise measuring device

**Figure 4.** Personel noise exposure measuring device

Multiple factors are involved in determining the measurement strategy. These are factors such as the purpose of the measurement, the complexity of the business situation, how many workers are required, the effective length of the working day, the time available for measurement and analysis, and how much detailed information is required. For the phase of assessing workers or homogeneous noise exposure groups, the nominal day is divided into tasks. Every factor contributing to the noise has been taken into account. The duration of the tasks was determined in consultation with the employees and those responsible. Alternatively, multiple employees and supervisors were consulted to determine the most appropriate timeframe. Measurements were made three times for at least five minutes for each task. The measurement was made by positioning the noise measuring device in the study area at a distance of approximately 1 meter from the noise source in the study area. Measurements were made by attaching the personal exposure measuring device 0.1 m away from the inner ear canal to the head of the shoulder and approximately 0.04 m above the shoulder. These values, which were found as a result of the measurements, were compared with 85 dB(A), which is accepted as the high exposure action value for noise, and the noisy environment and personal noise exposure status of the carpet businesses were evaluated with separate graphs and tables.

## 3. RESULTS and DISCUSSION

In this section, within the five identified carpet factories, personal noise exposure measurements (PNEM) were made on both the workplace environment measurements and the workers working in noisy areas. Since there is no regulation on environmental measurements in the legislation, no assessment has been made but PNEM are compared with the action values and limit values specified in the legislation's regulation. Environmental measurements in work areas and PNEM were evaluated together. Businesses are compared within themselves and with each other. The same work areas in different enterprises and evaluations of the measurement results in the same worker were made and if there are differences, the reasons for these differences were tried to be explained.

Noise ambient measurements (Table 6) were realized on the different areas in the factories and then according to PARETO analyses the most important areas are selected as weaving machine working area, carpet back coating working area, engraving machine working area pneumatic table worker, and automation machine operating area.

The PNEM values of workers in Factory 1 where there is continuous noise exposure and the noise level is considered high are given in Table 7.

**Table 6.** Noise ambient measurements of Factories

| **Place of Measurement** | **Measured Value $L_{eq}$dB(A)** | | | | |
|---|---|---|---|---|---|
| **FACTORIES** | **1** | **2** | **3** | **4** | **5** |
| Weaving Machine Working Area | 83 | 82,6 | 87 | 87 | 88 |
| Carpet Back Coating Working Area | 74,8 | 78 | 76,3 | 79,4 | 79,2 |
| Engraving Machine Working Area | 75,7 | 77,2 | 82,8 | 89 | 88,7 |
| Automation Machine Operating Area | - | - | 77 | 83,5 | 80,5 |
| Pneumatic table worker | 71,9 | 78,5 | 82,4 | 79,2 | - |

**Table 7.** PNEM values of Factories

| | Employee Mission / Work | The measured value within 8 hours $L_{EX,8h}$ dB(A) | The Highest Exposure Action Value dB(A) | Limit Exposure Value dB(A) | The measured value within 8 hours $P_{tepe}$ dB (C ) | The Highest Exposure Action Value $P_{tepe}$dB( C) | Limit Exposure Value $P_{tepe}$ dB( C ) |
|---|---|---|---|---|---|---|---|
| **Factory 1** | Weaving machine worker | **83,5** | 85 | 87 | 100,1 | 137 | 140 |
| | Engraving machine worker | **89,9** | 85 | 87 | 111,6 | 137 | 140 |
| | Pneumatic table worker | **84,1** | 85 | 87 | 107,9 | 137 | 140 |
| **Factory 2** | Automation worker | **85,7** | 85 | 87 | 105,2 | 137 | 140 |
| | Pneumatic table worker | **81,9** | 85 | 87 | 104,4 | 137 | 140 |
| | Weaving machine worker | **87,6** | 85 | 87 | 104,1 | 137 | 140 |
| **Factory 3** | Automation machine worker | **81** | 85 | 87 | 90,6 | 137 | 140 |
| | Weaving machine worker | **89,1** | 85 | 87 | 96 | 137 | 140 |
| | Transfer department worker | **81,9** | 85 | 87 | 99,2 | 137 | 140 |
| **Factory 4** | Weaving machine worker | **91,4** | 85 | 87 | 108,8 | 137 | 140 |
| | Engraving area worker | **91,9** | 85 | 87 | 110,8 | 137 | 140 |
| | Automation worker | **81,9** | 85 | 87 | 101,6 | 137 | 140 |
| **Factory 5** | Weaving machine worker | **90,8** | 85 | 87 | 105,5 | 137 | 140 |
| | Automation worker | **85,7** | 85 | 87 | 103,1 | 137 | 140 |
| | Engraving worker | **90,1** | 85 | 87 | 110,6 | 137 | 140 |

According to the results given in Table 7, personal noise exposure (PNE) in the engraving machine worker is 89.9 dB (A), which is above the exposure limit 87 dB (A), which is determined according to the regulation. It has been determined that the personal exposure values detected in the weaving machine worker and the pneumatic table worker are higher than the lowest action value of 80 dB (A). That is to say, in this case, it is considered that the engraving machine is not at a tolerable limit for the employees, and it poses a risk.

When the values given in Table 6 and Table 7 are evaluated together both ambient noise and PNEM have been found to be identical for weaving machine workers. For pneumatic table and engraving machine workers, the results of personal exposure measurements appear to be quite high compared to the ambient measurements. The reason for this is that the worker whose PNE is measured; stays close to the source of noise throughout the duration of the action. PNE value of the automation machine worker is greater than the maximum action value of 85 dB (A) specified in the regulation. The average PNE values in edge cutting and weaving machine workers are higher than the exposure limit value of 87 dB (A). It has been found that the exposure value of the dust absorber machine worker is higher than the highest action value of 85 dB (A). In this case, it can be decided that the workers in these areas are in the risk group in terms of noise. The reason why the PNE generated by the pneumatic table, automation, and the lark-shaving worker is higher than the noise level in the working area is due to the worker working close to the noise source as in Factory 1. PNE of workers in weaving machines was found to be higher than the exposure limit value of 87 dB (A) specified in the regulation. This value is higher than the limit value in terms of regulation, it can be said that noise is very risky. It has been determined that the PNE values in the automation machine and the personnel working in the transmission sections are higher than the minimum action value of 80 dB (A) specified in the regulation. PNEs occurring in workers of weaving machines and engraving machines are greater than the exposure limit value of 87 dB (A)

specified in the legislation. It is also seen that the PNEs occurring in the air table and automation machine employees are higher than the lowest action value of 80 dB (A). When evaluating these results, it can be said that noise level is dangerous for weaving machines and engraving machine workers as it is in other companies. When the PNE values of the workers of Factory 5 are examined, it is considered that the most noise exposure workers are weaving machines and engraving machines workers. Exposure values in these workers were found to be higher than the exposure limit value of 87 dB (A) which is specified in the regulation. It has been observed that PNE in the automation machine worker is higher than the highest action value of 85 dB (A) specified in the regulation. According to these results, the noise level is seen as a danger for workers of weaving machines, carving machines, and automation machines.

### 3.1. General Evaluation of Carpet Factories in terms of Personal Exposure to Noise

In this study, noise levels were measured both in the workplace and in personal workers; however, it has been decided to make the evaluations according to the results of PNE in terms of compliance with the changing regulation as mentioned before. The tables made for each business are compared within themselves and the difference or similarity between the noise levels is explained.

The most important machinery for carpet operations is the weaving machine. The weaving loom work area is the area where the main work is done. It can be considered as the most important work area in the enterprise that the carpet touches. Figure 5 shows the working area of the weaving machine and weaving machine

**Figure 5.** Weaving machine and weaving machine working area

When the figures are examined, it is clear that the operators are standing very close to the machine continuously. As the use of these machines requires experience, machine operators are exposed to the same noise pattern for years. When the results are examined, it is seen that the highest noise level occurs in this section. In this part of the study due to these reasons, in particular, the level of noise experienced by the weaving machine workers in all mills where the measurements are done is compared and presented graphically in Figure 6.

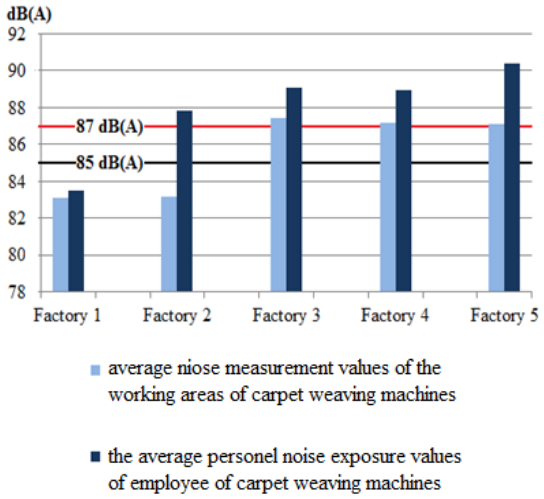


**Figure 6.** Measured PNE values for workers working in weaving machine and noise ambient measurement in weaving machine working area

As seen in Figure 6, it is seen that the PNE values of weaving machines workers are generally above the noise level of 87 dB (A), which the regulation specifies as the exposure limit value. In this study, the average individual noise exposure values of workers in weaving machines were measured as 88.3 dB (A). The results are consistent with the literature [19]. According to this situation, in carpet weaving factories, there is a high risk of noise for weaving machine workers

When the results of measurements made for other workplaces in the enterprises are evaluated; it has been found that noise levels are higher for engraving machines than for weaving machines. The engraving machine working area is a work area where carving or patterning is performed on carpet surfaces with a machine similar to a shaving machine. Figure 5 shows the photograph of the engraving machine and operator during operation.

As can be understood from Figure 7, the engraving process is carried out by the personal operators in the working subjects. Since this process causes a continuous noise, the measurement results made in this section are also taken into consideration. The graph drawn using average values for both personal and ambient noise measurements are given in Figure 8.

**Figure 7.** Engraving operation and engraving machine working area

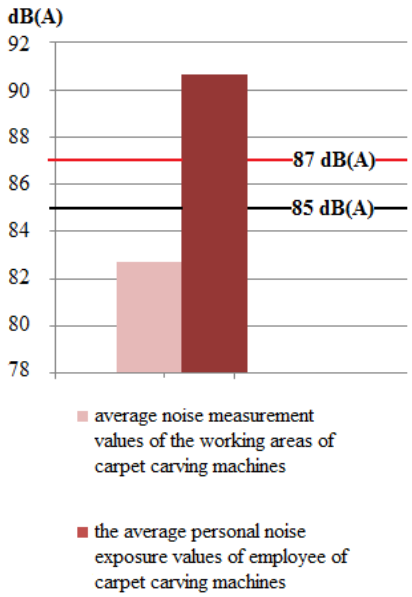


**Figure 8.** Engraving machine work areas average noise level and average noise in workers working in engraving machines personal exposure values

As shown in Figure 8, the PNEM results for engraving machine workers are also above the exposure limit value of 87 dB (A).

When the weaving machines that are being measured in the factories except engraving machine are measured; the ambient noise levels and the PNEM on the workers in these areas are generally parallel to each other for the same working areas. In addition, it has been determined that personal exposure measurements are generally higher in the workplace than in the workplace. There is a difference only in the lark shaving part. The carpet back coating department is a working area where defects of the body are removed and various mechanical and chemical stances and durability are increased. The photographs of the division in which the study area and measurement are made are presented in Figure 9.

**Figure 9.** Carpet back coating and working area

In carpet back coating machine workers, the measured values of personal exposure were lower than the ambient noise level. The reason for this is that the worker working in that department is away from the source of noise and waiting next to the control panel for machine control. In Factory 2 only, the PNE in the Carpet back coating employee is higher than the work area noise level. The reason for this is that the control panel that the worker is standing beside his task is positioned close to the air compressor, another noise source. The described positions are simulated in Figure 10.

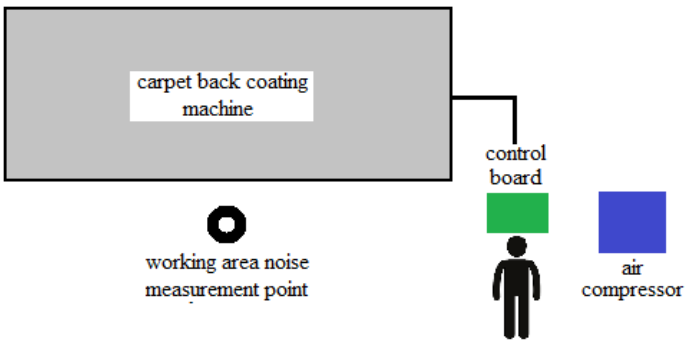


**Figure 10.** Location of the air compressor and control panel causing the Factory 2 personal exposure to be high

In addition to these, another work area where noise detection is performed is the pneumatic table. This table is a working area with a machine that makes it easier to sew the edges of the carpets or to smooth the carpets, and to move the carpets comfortably with the air blowing from the holes in them. Photographs of the said machine and operator are presented in Figure 11.

The noise level of pneumatic table working area is higher than PNE but it is not a noise risk since it is lower than the highest action value of 85 dBA.

As a result, it can be said that the working areas (textile machine and engraving machine) where the main work is done in carpet

operations are high-risk areas in terms of noise. In these areas, workers are obliged to wear earplugs. In other work areas where the measurements are made it can be said that the noise level is not at risk but at a height that cannot be overlooked. In these sections, workers have the obligation to keep earplugs.

**Figure 11.** Pneumatic table and pneumatic table working area

## 4. CONCLUSION

Noise is a very important factor as human power is made in every sector as well as in the textile industry in terms of occupational health and safety in carpet weaving factories working with high noise level machines Especially noise level In this study, the noise levels of the working areas, as well as PNE values imposed by the legislation in the workers working in these fields, were measured and examined in five factories serving in the carpet weaving sector. For this purpose, measurements were made in five carpet weaving factories in Gaziantep with different qualities. As a result of the measurements, it was determined that the work areas with the highest noise levels are the working areas of weaving and engraving. Again, it has been seen that the workers who work in the most active areas are most exposed to the workers who work in the weaving section and carving section of the PNE. The measured values exceeded the highest action value of 85 dB (A) and the exposure limit value of 87 dB (A), as determined in our legislation. This situation shows that the workers of the weaving and carving department of carpet weaving factories are at very serious risk in terms of noise-related risks. Although the number of machines, the production capacity, and the number of workers are different in the factories, the measured values are close to each other. This situation has revealed that when noise exposure is assessed, these factors should be ignored. In carpet weaving factories, the level of noise they are exposed to during the course of daily work does not change as each worker has a fixed duty. This is exemplified by the fact that the weaving worker is only present in this section during working hours. Moreover, since the weaving department is a very fast-moving process and its continuity is requested by the employers at the maximum level, immediate intervention and re-operation of the machine at the smallest yarn break is another factor that increases the worker's noise exposure during the course of the day. This increases the risk of the worker's noise. Some differences between ambient noise measurement levels and personal exposure noise levels were also found in the noise measurement areas beside the weaving and engraving department. These differences are particularly related to the place where the workers stop due to their duty, the distance or proximity to the source of noise during operation, and the distance to the location where another source of noise is performing the task. For example, in carpet back coating machine workers the ambient noise measurement levels are higher than PNE levels. The reason for this is that the worker in this section is moving away from the source of noise and is standing next to the control panel to control the machine in the vicinity. In Factory 2 only, PNE of this department is higher than that of the ambient noise level. The reason for this is that the compressor, which is another noise source, is positioned beside the control panel. This clearly shows that in the factory setting, machine layouts, or organizational arrangements in general terms, are very important for noise exposure in the workplace in terms of occupational health and safety. In the automation section, which is another field of study, it has been found that the distance to the noise source during the working has decreased or increased the PNE. For example, in Factory 2 and Factory 5 the PNEM is higher than the ambient noise level, while in Factory 3 and Factory 4 the PNEM is lower than ambient noise measurement. This determination also revealed the necessity of informing the workers how to act and where to work during the work. Thus, exposure to noise can be minimized. One of the most important preventions that workers should take to reduce this exposure is to use ear protectors regularly when working in parts of plants where PNE is high. The ear protectors used were found to be plug-type protectors. Employers need to check and audit ear protection more frequently to protect workers from the risks associated with noise. As an ear protector, preferring a higher cuffed ear protector that has the SNR (damping) value will be better to reduce noise exposure. In addition to all these considerations, the preventions that can be taken to minimize the

daily PNE of workers in carpet weaving factories can be listed as follows:

- If it is possible use a low-noise loom and engraving machine,
- To take care of weaving machines and engraving machines at regular intervals,
- Properly fixing the weaving machines to the floor,
- If there is an unnecessary noise source in the working environment, remove this unnecessary noise source in the working environment
- If it is possible, to inform employees about noise sources and distances during their duties, and to mark and determine locations where they will work.
- Do not place the weaving machines and engraving machines too close together,
- Covering the walls of the room where the weaving machines are located with absorbent and / or anti-reflection materials,
- Placing plates between the weaving machines to prevent noise from neighboring machines
- To ensure the using ear protectors daily and audit the use of it regularly to decrease the PNE below the regulatory limit.
- Train workers regularly to conduct hearing tests and use personal protective equipment.

As a result, in this study, the noise levels in the carpet factories were measured, the exposure that the workers made in this noise were determined, and the recommendations were made for the workers to be less affected by this noise. When both test results for the noise measurement were evaluated together, the personal exposure values were found to be higher than the noise levels in the working environments. This explains why the regulation on the protection of workers from noise-related risks requires the use of personal exposure values.

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