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M.Sc. in Textile Engineering

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UNIVERSITY OF GAZİANTEP

GRADUATE SCHOOL OF

NATURAL & APPLIED SCIENCES

NOISE EXPOSURE ANALYSIS IN CARPET FACTORIES: A GAZİANTEP STUDY

M.Sc. THESIS

IN

TEXTILE ENGINEERING

BY

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Supervisor

Assist. Prof. Dr. Züleyha DEĞİRMENCİ

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I declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Mehmet İlker BOZKURT

ABSTRACT

NOISE EXPOSURE ANALYSIS IN CARPET FACTORIES: A GAZİANTEP STUDY

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M.Sc. in Textile Engineering
Supervisor: Assist. Prof. Dr. Züleyha DEĞİRMENCİ
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Every year in our country, a large number of people die in the workplace, become disabled or suffer from occupational disease like in the World. This not only affects human life, but also causes serious damage to the country's economy.

As in many sectors, the textile sector has considerable dangers and risks in terms of occupational health and safety. One of these dangers is noise.

In this study, measurements were made in five carpet weaving factories in Gaziantep in order to determine working environment noise levels and personal noise exposure levels of working people in carpet weaving factories with noisy working ambient in textile sector. In the measurements made, it was seen that the personal noise exposure was higher than the noise levels in the working ambient.

In carpet weaving factories, it has been determined that most personal noise exposure occurs in weaving machine workers and carving machine workers. These values were found to be higher than the upper action value of 85 dB (A) determined by the regulation and 87 dB (A) of the exposure limit value. In carpet weaving factories, employees in these sections are at very high risk due to noise. Some measures that can be taken against noise-induced risks are specified in carpet weaving plants.

Key Words: Noise exposure, occupational health and safety, carpet factories

ÖZET

HALI İŞLETMELERİNDE GÜRÜLTÜ MARUZİYET ANALİZİ: GAZİANTEP ÖRNEĞİ

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Dünya'da olduğu gibi ülkemizde de her yıl çok sayıda insan işyerinde, iş kazası sonucu hayatını kaybetmekte, sakatlanmakta veya meslek hastalığına yakalanmaktadır. Bu durum insan hayatının etkilenmesi yanı sıra ülke ekonomisi için de ciddi zararlara neden olmaktadır.

Birçok sektörde olduğu gibi tekstil sektörü de iş sağlığı ve güvenliği açısından oldukça fazla tehlike ve risk barındırmaktadır. Bu tehlikelerden birisi de gürültüdür.

Bu çalışmada tekstil sektöründe gürültülü çalışma ortamına sahip halı dokuma fabrikalarında çalışma ortamı gürültü seviyeleri ile çalışan işçilerin kişisel gürültü maruziyet seviyeleri tespiti için Gaziantep İlinde beş adet halı dokuma fabrikasında ölçümler yapılmıştır. Yapılan ölçümlerde kişisel gürültü maruziyetinin çalışma ortamındaki gürültü seviyelerinden daha yüksek olduğu görülmüştür. Halı dokuma fabrikalarında en fazla kişisel gürültü maruziyetinin dokuma makinesi çalışanları ve oyma makinesi çalışanlarında meydana geldiği belirlenmiştir. Bu değerlerin yönetmeliğin belirlediği en yüksek eylem değeri olan 85 dB(A)'dan ve maruziyet sınır değeri olan 87 dB(A)'dan yüksek olduğu görülmüştür. Halı işletmelerinde bu bölümlerde çalışanların gürültüden kaynaklı çok yüksek risk altında olduğu ortaya konulmuştur. Halı dokuma fabrikalarında gürültüden kaynaklı risklere karşı alınabilecek bazı önlemler belirtilmiştir.

Anahtar Kelimeler: Gürültü maruziyeti, iş sağlığı ve güvenliği, halı fabrikaları

To my father and mother…

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Occupational accidents and occupational diseases are the two biggest problems of work life. Although notice inadequacy and informality are in high levels; according to International Labour Organization's (ILO) datas, it is known that more than 317 million labours are having occupational accidents and more than 2,3 million people lost their lives due to work accidents and occupational diseases [1]. Those specified datas show that occupational health and safety are one of the most important factors of work life.

According to 2016 datas of Social Security Institution (SGK), there are 1.749.240 registered workplaces and 13.775.188 registered employees in our country. 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 [2]. As it is understood from those datas, textile sector has an important role in terms of employment population. And this makes the textile sector one of the most important sectors in terms of occupational health and safety for our country.

According to Social Security Institution's datas; 286.068 occupational accidents happened in 2016 in our country. While 1405 employees lost their lives, 597 employee got occupational disease by those accidents [2]. Much more than those counts shows up as incapacity due to injury, losing labour partially or loss of limb. 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 datas of Social Security Institution [2].

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.

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 (GSYİH) [1]. With the acceptance of the same ratio is identical in our country; when it is compared to the 2016 annual gross proceeds counts that are taken from Turkey Statistical Institute (TÜİK), It is predicted that the total cost of occupational accidents and occupational diseases is up to approximately 100 billion Turkish Liras annually [3]. Because of this reason, it should not be forgotten that preventing from occupational accidents is easier, humanistic and cheaper than covering the pecuniary and non-pecuniary damages that stems from occupational accidents.

Some regulatory laws has been introduced in order to prevent this kind of problems in work life in our country just like all over the world. Although some regulations about occupational health and safety were introduced in company with the “*Labor Law no. 4857”* in 2003, some problematic periods had been experienced because of regulatory uncertainty in work life until “*Occupational Health and Safety Law no.6331*” was introduced in 2012. While the importance of occupational health and safety has not been known in the working life, it has been planned that the scope of business life has expanded considerably and that it will cover the whole of the business life in a gradual way. It is aimed to establish and develop Occupational Health and Safety (OHS) culture with the contributions of OHS professionals (occupational safety specialist, workplace doctors, other health personnel) and Joint Health and Safety Units (JHSU), where services can be obtained. Although it is not in the desired level in our country, it can not be ignored that the road has been taken quite a bit. These regulations are a very important step in preventing accidents and occupational diseases in working life.

Framework that is drawn of this law is the most comprehensive text but also in Turkey with OHS, OHS responsibilities with employers and workers are defined accordingly. This law also has an important place in Turkey's European integration [4].

In Occupational Health and Safety Law, there are several regulations to prevent the danger, which exist in workplaces and to prevent the risks that would stem from those danger. In the scope of those regulations while occupational diseases, which may be formed due to workplace environment, can be precluded up to 100%, occupational accidents can be precluded up to 98% [1]. The results of statistics, which were committed by International Labour Organization in 199 countries, are seen on Figure 1.1 and Figure 1.2.

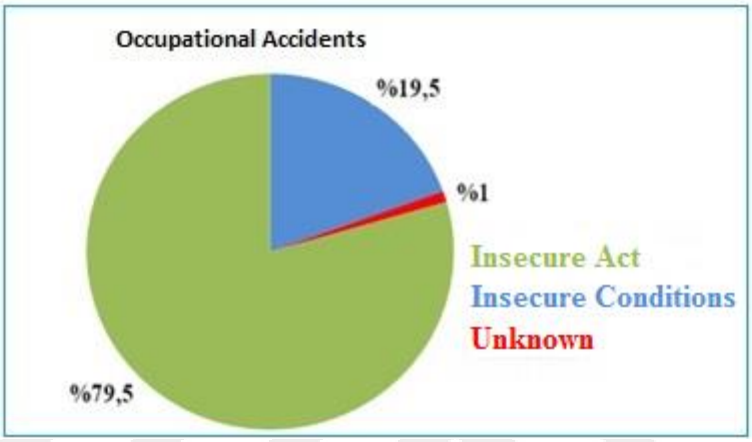

Figure 1.1 Reasons of occupational accidents

As it is seen on Figure 1.1 it seperates occupational accidents into three groups according to their reasons as 79,5% insecure conditions, 19,5% insecure act and 1% unknown reasons [5].

Again in another study also found that work accidents, 2% of out of human control, 10% were due to mechanical insufficiency and 88% were due to the human factor [6].

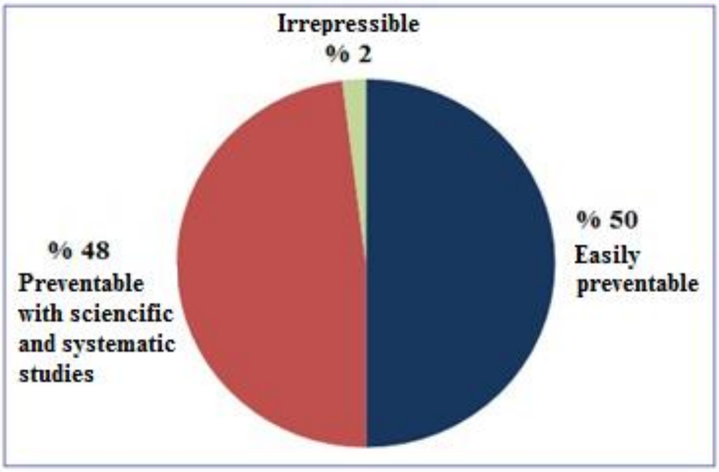

Figure 1.2 Statistics of occupational accidents' preventability

Nevertheless, in consequence of the same statistics, it is stated on Figure 1.2 that 50% of occupational accidents is simple preventable, and 48% of occupational accidents is contrallable with scientific and systematic studies [5].

1.2 Protection Methods in Occupational Health and Safety

The Occupational Health and Safety Law no.6331, which was introduced in order to be protected from the risks stemming from work life, identifies danger and risk concepts as such:

"Danger: It states the potential of damage and depredation, which is existing in the workplace or what can come from outside and what can affect the employee and workplace.

Risk: It states the possibility of injury, loss arising from the danger or some other harmful results.".

Likewise, the definition of risk and danger in *TS OHSAS 18001 Occupational Health and Safety Management System*;

"Danger: The source, condition, or process that could cause injuries or impairment of health or cause them to occur together.

Risk: The combination of the likelihood of a dangerous event or exposure to occur, and the severity of the injury or health impairment that may be caused by the event or exposure.”

Definition of occupational accidents and occupational diseases in *Occupational Health and Safety Law No. 6331;*

“Work Accident: An event that causes a mental or physical disability that occurs in the workplace or workplace, causes death, or disrupts body integrity.”
“Occupational Disease: disease caused by exposure to occupational risks”.

and

Occupational Health and Safety Risk Assessment Regulation means *"Prevention"* concept which is important for OHS;

“Prevention: It refers to all of the measures planned and taken to eliminate or reduce the risks related to occupational health and safety at all stages of the work carried out at the workplace.”

Similar to the same concept, TS OHSAS 18001 has the term "Preventive Action". A process to remove the cause of a potential non-conformity or other unwanted situation is called "Preventive Activity" [7].

<u>In order to be able to take the necessary occupational health and safety precautions at work, the definition of these concepts needs to be well known.</u>

The main purpose in risk assessment studies is to prevent danger. It is important to exterminate the danger in its source. If the danger can not be avoided, the risk becomes obvious and the risk struggle starts [7].

The Hierarchy of Risk Control Measures can be classified differently. This hierarchy of five steps;

1. Prevention of danger in the source
2. Reduce at source
3. Struggle with risk at source (engineering measures; ventilation, isolation etc.)

4. Administrative measures (workplace arrangement, education, organizational implementations)

5. Personal protective equipments

Engineering measures and administrative measures are also collective protection measures. In workplaces, collective protection measures must precede personal protection measures [7].

In summary, according to the *"OHS Risk Assessment Regulation"* dated 29.12.2012 risk control steps;

1. It is first struggled with the danger
   a. Remove danger and danger sources
   b. Substitute
2. If the danger can not be avoided, the risk will arise and the risk will be struggled in the environment, such as ventilation, isolation, workplace training, training etc. applied.
3. Personal protection practices

The order of measures to combat risk; resource oriented protection, environment oriented protection and personal protective equipments [8]. Also protection methods; provide for the improvement of two components of work accidents, “Insecure Conditions” and “Insecure Act” [7].

1.3 Resource Oriented Protection Implementations for Risk

● **Elimination:** It is the elimination of machines, process etc that constitutes risk in the workplace.

For instance;

Process 1 → Process 2 → Process 3 (Dangerous Process) → Process 4

Process 1 → Process 2 → Process 4

● **Substitution:** The replacement of a dangerous element with a non-dangerous or less dangerous one.

For instance;

Machine 1 ⟹ Machine 2 (Dangerous Machine) ⟹ Machine 3 ⟹ Machine 4

Machine 1 ⟹ Machine2/1 (Safe Machine) ⟹ Machine 3 ⟹ Machine 4

● **Machine Protectors:** This constitutes steady machine apparatus that does not hold extra risk in order to provide protection in the situations that can not be eliminated or the elimination with a less risky machine can not be done. The absence of machine protectors is also referred to as the "Insecure Situation" in the two components of work accidents at the same time. Machine protectors for textile business are shown in Figure 1.3.

Figure 1.3 Fly Frame with machine protector and carding-machine that is closed with gear systems protection cap. [9,10]

● **Technical Precautions:** They are implementations that are done in order to make work area much safer in machines and stands. These include safety valves in the pressurized boiler that allow excess pressure to be thrown out, and temperature sensors that sense the temperature change in the environment and are triggered when it reaches risky levels. Technical measures are also called "Engineering Measures".

1.4 Workplace Ambient Protection Practices for Risk

Automation, insulation, grounding, lighting, isolation etc. as well as many engineering measures aimed at mediation. These applications include organizational applications such as training, marking, measurement and maintenance. They are also called "Administrative Measures". Some mediation prevention practices are described below;

● **Isolation:** It is the isolation of risky sections or works from work environment or operating them in a seperated area.

● **Ventilation:** If there are implementations in workplace, there should be sufficient air circulation in the environment. This process is called as ventilation. It should be implemented in business made with chemical dust and mine.

● **Organizational Implementation:** Convenient planning of workplaces, using of the most confidential technology, measurement of the environment, making maintenance, setting, cleaning and putting safety signals which are shown in Figure 1.4.

Figure 1.4 Safety signals in organizational protection implementation [11]

1.5 Personal Protective Equipments for Risk

If precautions, which are taken with resource oriented and environment oriented implementations, remain incapable against existing dangers and risk that stems from these dangers, personal protective equipments should be used in order to be protected from these risks. Personal protective equipment should be considered as a last resort for occupational health and safety work. At the same time, recruitment examinations, periodic examinations, rehabilitation studies are also included in this title.

1.6 Obligations Belonging to Employee and Employer in Precautions in Workplaces

Employees' and employers' performing their obligations is the most important aspect in order to prevent from risks in workplaces. This is because employer should take precautions and implement them, while employee should adapt to these precautions.

1.6.1 Obligations Belonging to Employer

The most significant obligations to take necessary precautions in workplaces are belonging to the employer. Obligations of employer are ensured *in "Occupational Health and Safety Regulations", "Occupational Health and Safety Law no.6331" and "Labor Law no.4857".*

If these obligations of the employer are summarized, the employer takes all kinds of precautions in the workplace environment, prevention of the hazards, and necessary applications to remove or reduce the risks. However, to make the workplace environment suitable for occupational health and safety, to perform risk assessment or to have it done. Preparing emergency plans has to ensure that employees are admitted to the OSH boards. It is obligatory for workers to ensure that all kinds of equipment and equipments to be used against the risks in the workplace environment are prepared in accordance with the work, prepare and notify the instructions for use and ensure that they are used safely and according to the instructions by the workers. It also has to give information to workers about their duties, to inform them about the hazards and risks present at the workplace, to get the necessary trainings, to have periodic examinations of workers and to inspect and control all these applications.

It should not be forgotten that the employer does not remove the responsibilities of the employer for taking some services from outside experts or establishments, performing risk assessment, employing job security specialist and workplace physician and getting service from Join Health and Safety Unit (JHSU) for some obligations of the employer.

1.6.2 Obligations Belonging to Employee

After neccessary precautions are taken by employer in work environment, obligations belonging to employee are ensured *in "Occupational Health and Safety*

Regulations" and also *"Occupational Health and Safety Law no.6331"*.

The most important task in terms of occupational health and safety (OHS) is to take the employer's instructions into account and to implement them during work. It is the obligation of the worker to avoid dangerous behaviors while doing his job, to report to the employer and / or the OSH Board any deficiencies he has seen in the working environment, to error or misconduct, to use personal protective equipment and equipment provided by the employer in a careful and orderly manner. They have to obey and follow the signs in the working environment in the direction of health and safety.

1.7 Dangers and Precautions to be Taken in Terms of Occupational Health and Safety in Textile Sector

Textile sector holds several dangers and risks in terms of occupational health and safety. There are several works which are done with both machines and chemicals in textile sector's work environments. Besides, almost all of these works are done with man power, this is why employees are directly exposed to these risks and dangers.

For example, the noise level in yarn, weaving and knitting operations is very high, larger machines, density of dusty environments, fire due to easy ignition of fibers, thermal comfort due to high ambient temperature, belt-pulley parts of machinery and equipment and dangerous welds originating from rotary cylinders; painting and dyeing in finishing and dyeing enterprises and chemical-induced hazards are at the forefront with the effects of carcinogen. Ergonomic hazards caused by posture disturbances, needle sticks welded by sewing machines, burns in the work of cutting, ironing, long working hours and informality are the foregrounds in the apparel or ready wear enterprises which are working hard in labor [4].

1.7.1 Dangers Originating From Powders

There are several work environments that hold dangers originating from powders in the sector. Besides, risks, occuring in these work environments, cause occupational diseases and deaths originating from these risks. The most important respiratory occupational diseases originating from powders are the two diseases named as*"Bissinozis"* and *"Silicosis"*.

Bissinoz; It is a typical occupational lung disease which happens as a result of being exposed to the powders of natural fibers like cotton, flaxen, cannabis and jute during long years in textile sector [14].

Silikozis; It is possible to identify this disease evaluated in occupational diseases classification under pneumoconiosis topic, and pneumoconiosis is a tissue reaction against accumulating of mineral powder in lung [14]. Silikozis disease in textile sector was seen first time in 2005 in our country [8]. Especially these diseases are seen mostly with the jean sandblasting and coalmines employees who work at unregistered under the counter workplaces in which no precaution is taken. Their lung x-ray is shown on Figure 1.5.

Figure 1.5 Denim sandblasting employees and lung x-ray of a sandblasting employee working without protection after two years [12,13]

Table 1.1 shown below is respecting occupational respiratory system diseases arising from male and female employees according to the 2016 datas of Social Security Institution.

Table 1.1 The number of occupational diseases and afflicted employees according to the 2016 datas of Social Security Institution

DIAGNOSTIC SUBGROUP	**The number of Social Insured Employee Afflicted of Occupational Diseases**	
J Group Respiratory System Diseases	**Male**	**Female**
J34.8 – other identified failure of nose and nasal sinüs	0	1
J45.0 -Asthma, allergic	0	3
J45.1 -Asthma, intrinsic (non-allergic)	1	0
J45.9 -Asthma, unidentified	3	1
J60 –coalmine employee pneumoconiosis	71	0
J61 -pneumoconiosis, asbestos and connected to other mineral fibers	6	0
J62.8 -pneumoconiosis, connected to other powders including silicium	118	0
J63.0 –Aluminosis	1	0
J63.8 –Unfinished factor, other	1	0
J66.8 –Airway disease, connected to other identified organic powder	1	0
J68.1-acute lung oedema; chemical material, gas, smoke and connected to vapours	2	0
J68.2 –Upper respiratory tract inflammation; chemical material, gas, smoke	2	1
J68.3-Acute ve subacuterespiratory tract condition, other chemical materiak, gas, smoke andconnected to vapours	1	0
J84.1 –İntersititial pulmanorydiseases, other, fibrosis	3	0
TOTAL	**216**	

*“Conflict With Powder Regulation”*was introduced to prevent from the risks originating from powders in work environments. Employer should carry out the prevention and protection implementations according to Employer Regulation Provisions. Exposure limit values originating from powder should be known in order to take protection implementation methods. Exposure Limit Values about some powders that should present at workplace is shown on Table 1.2.

Table 1.2 Powder exposure limit values in work environment according to regulation

Name of Material	CAS No (1)	Total Powder Quantity TWA/ZAOD (mg/m3)(2)	Respirable Powder Quantity TWA/ZAOD (mg/m3)(2)
Farina	9005-25-8	15	5
Cotton dust (gin, blowroom, yarn)	-	-	0.5
Cotton Dust (Weaving)	-	-	0.75
Cotton Dust (Outfit)	-	-	1
Calcium Silicate	1344-95-2	15	5
Linen	463-51-4	0.5	0.9
Aliminium Metal	7429-90-5	15	5

(1) CAS: Service registration number of chemical substances.
(2) mg / m^3: the amount in milligrams of the substance in air at 20 °C and 101.3 kPa (760 mm mercury pressure) in 1 m^3 air.

Some important protection implementations against risks originating from powder in textile workplaces are stated in Table 1.3;

Table 1.3 Protection methods against powders in textile workplaces

Resource Oriented Protection Implementations	
Elimination	To remove works that cause powder
Substitution	To exchange works with less powdered works if they can not be removed
Machine Protectors	To prevent powder spreading to workplace with suitable protectors if a working machine or device causes powder
Technical Precautions	To make powder source a less dangerous condition with suitable filters in order to prevent powder spreading
Environment Oriented Protection Implementations	
Isolation	To seperate works causing powder from working area.
Ventilation	To ventilate the environment if powder causing works can not be isolated
Organisational Implementations	Doing works causing powder with less employees, to put necessary warning signals in powdered area, to get powder measurement done regularly in work area, keeping working area clean, holding WC and bath near working area
Personal Protective Equipments	
It is to supply suitable equipments like mask, gloves convenient to hygiene and usage conditions.	

1.7.2 Dangers Originating From Work Equipments and Moving Parts

There are a huge number of moving parts in work equipments, used machines and stands in textile sector and these components constitutes danger for work environment. This situation increases the risk of employess' jamming their arms, hands or fingers in these dangers or it increases the risk of causing their death. Statistical figures show that the compression of the limb to the machine and the equipment is high.

Figure 1.6. Weaving machine rapier hoop with protector and without protector [8]

Figure 1.7 A working press machine while its cover is open [8]

“Health and Safety Conditions Regulations in Using Work Equipments” was introduced in order to prevent risks originating from work equipments in work life. The cases stated in regulation provisions should be fulfill in work environment, equipments and machines. Necessary protective precautions against moving parts and equipments should be taken, employees should be informed well about the machines they use, the machines should be used according to usage instructions and they also should be maintained periodically in order to reduce their risk level. Periodical maintainance duration and points to be considered in these maintainance stated in the regulation of some machines, facility and equipments in work environment are listed below in Table 1.4.

Table 1.4 Periodical maintainance duration for equipments and facilities designed according to regulation

Name of Equipment	Control Period (Maximum Duration) (providing the duration predicted by related standart remain hidden)	Periodical Control Duration
Ventilation and Air Conditioner Facility	1 Year	It is done to be intended for stating suitability of criterias specified in the project
Tanks and Depots Holding Dangerous Liquids(4),(5)	10 Years	API 620, API 650, API 653, API 2610 It is done suitable to criterias specified in standarts.
Stowage Machine (forklift, pallet jack, lift)	1 Year if the duration is not specified in standarts	It is done suitable to criterias specified in TS EN 1495 + A2, TS EN 1808 ve TS EN 12811-3 standarts and it is done considering criterias 4.article of Annex-II

(4) Hazardous liquids: they are abrasive or harmful to health.
(5) Nondestructive inspection methods are used.

Some important protective implementations, taken against risks originating from moving parts and work equipments in textile workplaces are summarized in Table 1.5.

Table 1.5 Precautions which will be taken against dangers originating from moving parts and work equipments in textile workplaces

Resource Oriented Protection Implementations	
Elimination	To remove risky machines, equipments etc. from the workplace
Substitution	To exchange risky machine or equipments with less risky ones.
Machine Protectors	Covering moving parts with a durable material while an employee works. Holding the yarn delivery parts of sewing machines in order to reduce danger
Technical Precautions	Installing stop buttons and sensors near the employeein case of a problem with the machines. Installing photocell facility against the possibility of employee’s lapping his/her hand while pressing process of trash with double hand command, cover locks etc in weaving machines.
Environment Oriented Protection Implementations	
Isolation	Moving sustained non-active and portable machines and equipments from working area to a suitable area after the work finishes.
Organizational Implementation	Locating moving parts and equipments in a non risky way in workplace. Getting air conditioner, electric and boiler equipments’ periodical maintainance done regularly. Training employees about the machines they use. To mark working area of forklifts which are used for transportation of cotton and yarn or some other purpose. To ensure that forklifts, blends, cotton fluffers, harrows, rings, wick, weaving etc machines are used only by authorized people about that profession.
Personal Protective Equipments	
Gloves are for providing of protection employees from hot surface in workplaces or in paint shops from boilers. Eyeglasses, mask etc are for protecting employees from the risks originating from vapour in works that holds vapour boilers.	

1.7.3 Dangers Originating From Work Process and Non-Ergonomic Working Conditions

Ergonomi is the sicence of making the work and work environment proper to employees. Ergonomi is not only such an important concept for textile sector, it is also so important for all sectors. The textile industry is an industry where labor is spent, and the power of the human being is used excessively and continuously. In the textile sector, works such as ready-made garments, models and drawings are sitting, re-moving and heavy lifting.

The concept of anthropometry needs to be known in order to understand ergonomics about OSH. Anthropometry and ergonomics are two different terms that are often intermingled and used interchangeably from time to time. Anthropometrythe scientific study of the measurements and proportions of the human body [7].

Some precautions, which are taken against risks originating from work, process and non-ergonomic working conditions, are summarized in Table 1.6.

Table 1.6 Precautions which are taken against work, process and non-ergonomic working conditions

Resource Oriented Protection Implementations	
Elimination	Removing non-ergonomic work or process from working area if it is possible
Substitution	To exchange work, process or machines that disturbs the employee with a more ergonomic, a less disturbing work, process or machinrs
Technical Precautions	Making work, process and non-ergonomic working conditions more suitable with necessary engineering and scientific methods. Setting up chair and table height for outfit employees who work sedentarily. To make adjustment of computer or device screen up to eye level for designer who work on a computer or sedentary quality control employees and machine operators looking at machine's screen. Providing sufficient lighting of working area for quality control employees.
Environment Oriented Protection Implementations	
Isolation	Seperating components which are spoiling ergonomi from working area
Ventilation	Keeping the working area ergonomic with proper ventilation precautions in order not to disturb employees who work in the same area just as laboratory employees.
Organizational Implementations	To inform employees about working positions. To put parts, devices or components in proper way for outfit employees, who work in a stable position or who take care several works at the same time,
Personal Protective Equipments	
Supplying necessary personal protective equipments, which give ergonomic contribution, for employees in textile workplaces.	

1.7.4 Fire

Fire is chemical incident that can not be controlled and it happens when burner and burning materials meet up. Fiber is the most important raw material of textile sector. Because fiber is combustible, one of the most important occupational safety risk of the sector is fire. Oxygen, burning material (fiber) and fire source are enough for a fire outbreak. Fiber, what is raw material of textile and combustible, is seperated into two groups itself [8].

a. Natural Fiber:

• Animal Fibers (wool, silk, cashmere etc.)

• Vegetable Fibers (cotton, linen, cannabis, jute, etc.)

b. Chemical Fiber

• Synthetic fibers (polyamide, poliester, polypropylene, polyurethane, polyethylene etc.)

• Regenerated fibers (viscose, cellulose acetate, rayon etc.)

Along with the possibility of those raw materials cause a fire outbreak, the chemicals which are used in textile sector should be accepted another factor, as well.

"*Reglation About Protection of Buildings From Fire*" was introduced in order to reduce loss of life and property happening on fires which can occur during manufacturing, maintainance or restoring of state institutions and organizations, buildings that are used by natural and legal people or workplaces.

According to related regulation, workplaces are classified accordingly their production sector in terms of danger. Workplaces belonging to textile sector are stated according to their production field on Table 1.7

Table 1.7 Classification of textile workplaces according to regulation

Usage Type	Danger Rank
Textiles and Readymade	
-	Ordinary Danger - 1
Leather Ware Factories	Ordinary Danger - 2
Carpet factories (except rubber and foam plastic), fabric and cloth factories, fiber plate factories, shoe factories, trikot (knitting), home textile (cloth) factories, bed, blanket factories (except foam plastic), sewing and weaving shops, wool and duffel shops	Ordinary Danger - 3
Cotton spinning mill, linen and hemp preparation plants	Ordinary Danger - 4
Upholstery fabrics and linoleum fabrics fabrics and linoleum flooring fabrics	High Danger -1
Note: If there are areas where you have a high fire load, such as painting in the medium hazard-1 and medium hazard-2 areas of use, the areas of use are considered as medium danger-3	

Fibers should be well known in order to take sufficient precaution against fire and in order to response in the most proper way in textile workplaces. Because, the fire risk of fiber, what is one of the most important components of textile workplaces, differs accordingly its type. The type of manufactured production or raw material, its current form and its storage type are directly efficient in increasing or decreasing the risk of fire. Increasing and decreasing cases of fire risk are summarized below.

property type	fiber type	deflagraton speed	fire spreading speed	
messy formed fabric trash, messy fibers	poliester acrylic polyethylene syntetic fiber and blend those	deficit fabric presenting at a messy bundle	extreme fabric and fiber stack, insufficient corridors between stacks, easy air flow	High Risk
spent product package, composite products etc.	cellulose fibre cotton, viscose	extemely vertical stocked fabric, fiber trash	tracked storage	
			stocking on metal shelf	
woven fabric rool, erwrapped yard package	silk - wool	extremely stocking in cardboard box	stocking in a room which has restricted air flow, no window and a closed door	
	PVC	stocking in metal boxes		Low Risk

Figure 1.8 Risk situation of raw materials and products accordingly their storage type in textile workplaces [8]

One of the most important elements for fighting fire in the workplace is to interfere with the fire tube suitable for the burning material. This situation is also vital for fire fighting. Because of the possible use of a false extinguisher, the fire can easily be increased or difficult to extinguish. Examples of fire tube selection according to combustible materials are given in the Table 1.8.

Table 1.8 Fire tube selection according to flammable material [15]

Fire Classes	Type Of Fire	Water	Foam	ABC Dry Chemical Powder	CO_2	Halon
A	Paper, Wood, Fabric	x	x	X	-	-
B	Flammable liquids Machine oil, Natural gas, Oil	-	x	X	x	x
C	Electric cables, Control	-	-	X	x	x
A&B	Combination of flammable liquids and gases with flammable materials	-	-	X	-	-
A&C	Flammable materials and electrical combination of tools	-	-	X	-	-
B&C	Combination of flammable liquids and gases with electrical appliances	-	-	X	x	x
A,B&C	Combination of flammable liquids and gases and electric appliances of flammable materials	-	-	X	-	-
D	Burnable light metal fires fall into this class. (sodium,potassium, titanium, magnesium, etc.) Dry chemical powders it is used to put out the fires.	-	x	X	x	-
E	Fires in electrical installations fall into this class	-	-	-	-	x

Some precautions to be taken for a fire and some protection methods related to textile workplaces are summarized Table 1.9.

Table 1.9 Protection implementations against fire in textile workplaces

Resource Oriented Protection Implementations	
Elimination	Sending away electric cables, unused chemicals coloring matters, fibres or fabric trash that can result a fire outbreak in working area.
Substitution	Exchanging high fire risked fiber sor chemicals with less dangerous or free of risk ones
Machine Protectors	To prevent the fire from spreading to area by using protective covers or aparathus against fire stemming from machines, electric board or leaks
Technical Precautions	Keeping the electric cables which are used for machines or devices in workplace, in a canal. Making a closed type system of lighting which is used in the areas where powder fibers can cause a fire outbreak. Operating fire alarm system with a power supply unconnected to network. Putting sensors which are sensitive to smoke and heat. Mounting a residual current relay on the board.
Environment Oriented Protection Implemetation	
Isolation	Sending away fire sources from workplaces in which flammable materials are used, sending away calescent machine equipments. Keeping fibers, fabric and chemicals out of working area in a safe way. Seperating materials that can cause a fire outbreak when they react
Ventilation	Planning the ventilation component in a safe way against fire in textile workplaces. As oxygen level is important for fire volume, a special attention to the ventilation should be paid in the storage departments of materials that can cause a fire outbreak.
Organizational Implementations	Training employees for fire outbreak. Keeping fire extinguishers proper places. Getting periodical maintainance of equipments and facilities that can cause a fire outbreak and putting warning signals at proper places. Storage of fiber, fabric, yarn and chemicals should be done at the same place constantly and protecting this order. Non-packing of fiber, yarn, fabric etc near emergency exit or electric board.
Personal Protective Equipments	
Employer should make employees wear unimflammable business casual and employer should keep masks that can be used when a fire happen in high risked work places.	

1.7.5 Chemicals

Several numbers of materials like acid, alcali, salt, colorant, auxiliary chemicals etc are used in textile sector. Apart from workplaces which are making paint process, chemicals usage is not intense. Along with this; chemical usage are intense in first finish(washing, burning, whitening etc) painting, printing and finishing departments of workplaces [14]. Because of this reason the most risky part of textile sector is "Painting" workplaces.

Along with the change of work quality just like the other sectors in which chemicals are used, there are a lot of risks originating from chemical materials because chemical usage is common.

"*Regulation about Health and Safety Precautions in working with Chemical Materials"* was introduced in order to specified the conditions of workplace to provide a safe working area and in order to protect the employees' health from the risks stemming from chemical materials that are kept in workplaces and processed in these workplaces.

Employer should take necessary precautions not to exceed limit values of some chemicals'stated in Table 1.10, the employer should also prevent the employees' exposition of chemicals and make it minimum level accordingly regulation obligations in chemical works.

Table 1.10 Exposition limit values specified in regulation for works with chemicals

EINECS(1)	CAS(2)	Material Name	Limit Value				Special Mark(3)
			TWA(4) 8 Hours		STEL(5) 15 mins		
			$mg/m^{3(6)}$	ppm(7)	mg/m	ppm	
200-193-3	54-11-5	Nicotine	0.5	-	-	-	Leather
200-467-2	60-29-7	Dietileter	308	100	616	200	-
200-579-1	64-18-6	Formic acid	9	5	-	-	-
200-005-	64-19-7	Asetic acid	25	10	-	-	-
200-659-6	67-56-1	Methanol	260	200	-	-	Leather
200-662-2	67-64-1	Acetone	1210	500	-	-	
200-663-8	67-66-3	Chloroform	10	2	-	-	Leather

(1) EINECS: European Inventory of Existing Commercial Chemical Substances.
(2) CAS: Service registration number of chemical substances.
(3) Special sign: The "skin" sign indicates that the body can pass through the skin in significant quantities.
(4) TWA: Time-weighted average measured or calculated for a specified reference time of 8 hours.
(5) STEL: Exposure that should not be exceeded for a period of 15 minutes unless otherwise specified boundary value.
(6) mg / m^3 at 20 °C and 101.3 KPa. (760 mm mercury pressure) located in the air at 1 m^3 of pressure the amount of the substance in milligrams.
(7) ppm: Amount in milliliters of the substance in air of 1 m^3 (ml / m^3)

Along with occupational exposition limit values, chemical tanks that are used for storage in workplaces in which chemicals are used constitute danger. The range between some chemical tanks stated on Table 1.11 is ensured and it should be obeyed in textile workplaces.

Table 1.11 The ranges between liquid oxygen tank, liquide nitrogen tanks and liquid argon tanks stated in regulations

For liquide oxygen tanks	
Tank Capacity (m^3)	**Range (m)**
0-10	1
11-50	2
51-100	3
101-200	4
201-10000	5
For Liquide Argon and Liquide Nitrogen Tanks	
Tank Capacity (m^3)	**Range (m)**
0-100	1
101-600	2
601-1000	3
1001-3000	4
3001-10000	5

Some important protection implementations to be taken against the risks stemming from chemicals in textile workplaces is stated on Table 1.12.

Table 1.12 Protection implementations to be taken against the risks stemming from chemicals in textile workplaces

Resource Oriented Protection Implementations	
Elimination	Removing of implementation if a risky chemical is used or if there is a process with dangerous chemical
Substitution	Using less dangerous or free of risk chemical material instead of using dangerous ones.
Machine Protectors	When preparing a paint receipt in textile laboratory or using machines with chemicals, employer should provide the machine or the device in a proper way with seal cap in order to prevent the employee from exposition chemical vapour and chemical powder.
Technical Precauitons	Using easy effaceable materials on the walls and floor in order to clean the floor and the dust easily when a chemical process is being done in chemical section
Environment Oriented Protection Implementations	
Isolation	Sending away unused dangerous chemicals from working area, keeping it safely in another place. Stocking and measuring of paint materials and putting it in a hand barrow should be done in another section seperate from other chemicals.
Ventilation	Setting up a ventilation system for the sections in which measurement of colorant are done. Making chemical process in the sections closed on three sides and holding a forced draught ventilation system.
Organizational Implementations	Training employees about the chemicals which are used. Keeping MSDS (ingredient security information form), what holds informations about chemicals, in a place that employees can see easily, Turkish and legible. Providing works made with dangerous chemicals with minimum number of employees. Taking collective precautions, keeping workplace clean, getting measurement of environment perodically. Setting of the ranges between chemical tanks which hold different chemicals.
Personal Protective Equipments	
Providing proper protective equipments (gloves, eyeglasses, apron, shoes, mask etc) for the employees who work with allergen, harmful, corrosive materials that can be cause occupational diseases.	

The purpose of this study is; measuring the noise levels of five carpet manufacturing operations operating in Gaziantep in the carpet industry and comparing than evaluating the existing noise levels with the limits that are legalized. The carpet industry constitutes a large part of the Gaziantep's industry and this sector has a significant place in the economy of our country at the same time.

In the first part, general information about occupational health and safety in carpet weaving factories and textile applications are presented. In the second part, the main theme of the thesis is the noise term and the precautions to be taken and the precautions to be taken are explained in detail. The third section summarizes the studies that lead to the topic in the literature and overlap with the thesis. In the fourth section, the mills where the measurements are made are explained and the measurement and evaluation methods are represented. In the fifth chapter, the measurement results are explained with graphs and tables. In the last part, the results of the study were interpreted and recommendations were given in terms of the workers.

CHAPTER 2

NOISE IN OCCUPATIONAL HEALTH AND SAFETY

2.1 Noise in Occupational Health and Safety

Noise, what is identified as disturbing or unwanted sound, constitute being an important environment problem that affects human health and life quality in countries in which industralization and urbanization are experienced extremely. Along with this, the most affected population from noise is the ones who are working in industrial institutions in which high levels of noise occur.

Several various negative impacts just like permanent or temporary hearing disorders depending on the level, type and duration of noise, blood pressure increase, increase of breath rate, slowdown in heartbeat, sudden reflex, some behavior disorders, being tyson and stressful, decrease in quality of work, concentration disorder and slowing down of moves, are seen with people who work in noisy environment during long duration . Because of all these negative impacts, noise restrrain individual from doing his mental tasks and skills by giving discomfort feeling to the person, and it threatens health by disordering life quality [16].

On one hand, industrial development, what has started at 18.century and resumed still, provides simplicity and comfort in life, on the other hand it threatens human beings by being the reason of negative impacts on human health because necessary precautios are not taken or disobey to taken precautions [17].

More and more machines are being used in production system at the present time. This rise in mechanization and automatization has been increasing work speed and it has been making the work less interesting from time to time. On the other hand, labour intensive manufacturing is still going on and intense physical problems are encountered [18].

Person in mechanical production system performs his/her work in closed working areas. Both work environment and some negative impacts, which are originated from manufactured product and machines in this area, affects the safety and work success of manufacturing. The benefits of working in a healthy and safety environment not only protect the safety and health of employee, but they also increase productivity of workplace [19,20,21].

Development of technology is compelling skills of people working in manufacturing sectors in terms of mental and physical. Work productivity increases when the machines, which are designed to use individual's mental and physical skills more efficient and productive, are developed considering the talents and features of individual. Accordingly; in order that employees can work healthy, safe and efficiently, work area and necessary equipment should be organized with the factors like noise, vibration, lighting, temperature, humidity, dust etc. and work organization, systems devoted to management and communication structures should be organized according to constitutive, dimensional and psychological features of individual [22,23,24,25].

Noise is a sound spectrum that has arbitrary structure and it is defined as unwanted sound subjectively. Noise level or sound pressure level is the difference of athmospheric pressure, changing during sound propagation, to balance pressure [26]. It has its own unit, energy and average. the following sections also contain descriptions of noise and various statements regarding noise. With these explanations, noise will be learned even better

It is aimed to measure noise levels, compare and evalute existing noise levels to the limits approved by regulations in five carpet manufacturing business operating in Gaziantep industry which does have an important role in our contry economy and also it is aimed to retain and evaluate effects of noise level on employees with this study.

2.2 What is Noise

2.2.1 Some Definitions about Noise

Noise is the mechanical vibrations which are formed with pressure changes in unwanted and unpleasant solid, liquid and gas. Changes which happen in air pressure, reach to sense organs as waves and the result of this is heard as sound. Avibration is characteristically identified with frequence and its volume [27]. As 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 [28]. If a scientific identification is required, noise is an acoustic case that is depended on aggregation of harmonic and non-harmonic vibrations. In other words, noise is a sound spectrum which has a random structure [29].

As to industrial noise, it can be identified as sounds which affect work quality negatively and which impinge physiological and psycological impacts on employees in workplace [30]. Noise affects employees in different ways from back pain, irritability, nausea to inanttention and this affects work quality negatively.

Some concepts are given below about this topic [26,31,32,34].

Sound: It is the pressure change that can be perceived by the ear in the air, water and a so forth elastic environment.

Sound Pressure: It is the air pressure gradient.

Noise: It can be identified as unpleasant, unwanted or disturbing sound.

Impact Noise: It is the noise that shows up with the clash of two mass.

Sound Pressure Level or Noise Level: It is the difference of changing atmopheric pressure during sound propagation to balance pressure. Therms value of sound pressure (squareroot of quatratic mean, effective value) gives the most important information about sound pressure. The unity of sound pressure, which is proported to 0.0002 Newton/m^2standart reference sound pressure, is decibel (dB).

Decibel: Bel is the sound level that is equal to the proportion of a given sound level to ten times less another sound level according to logarithm to the base ten and 1/10 of this is identified as decibel.

dB(A): It is a sound evaluation unit in which medium and high frequency, to which human ear is sensitive the most, are underlined, Because of this reason dB(A) is used the most as a unity. dB(A) unit, which is used in noise decrease or control, is related to subjective evaluation of sound volume

dB(B): It is between A and C frequency and its usage is not common [33].

dB(C): C- nominal sound pressure level dB(C) is the best comparison for subjective sense of high sound pressure levels.[33]

Peak Sound Pressure (P_{peak}): It states the peak value of C-nominal noise pressure.

Level: Levels which are measured with decibel.

Sound Volume: It is the feature which changes depending on distance from source with the acoustic and geometric features of sound source environment.

Table 2.1 Some sound sources and their levels [35]

Source	Level	dB(A)	Multiples of Threshold
Threshold level	1.10^{-12} W/m^2	0	10^0
Leaf Rustling	1.10^{-11} W/ m^2	10	10^1
Whisper	1.10^{-10} W/ m^2	20	10^2
Normal Speaking	1.10^{-6} W/ m^2	60	10^6
Heavy Traffic in Street	1.10^{-5} W/ m^2	70	10^7
Vacuum Cleaner	1.10^{-4} W/ m^2	80	10^8
Major Orchestra	$6,3.10^{-3}$ W/ m^2	98	$10^{9.8}$
Maximum Sound of Music Player	1.10^{-2} W/ m^2	100	10^{10}
Frontrow of Rock Concert	1.10^{-1} W/ m^2	110	10^{11}
Jet Plane's Take Off	1.10^{2} W/ m^2	140	10^{14}
Eardrum Damage	1.10^{4} W/ m^2	160	10^{16}

Sound Power Level: It is the power of sound energy that is spread by a sound source

Amplitude: It is the biggest difference of sound pressure from atmospheric pressure at this point.

Period: It is the elapsed time for pressure change revolution.

Frequency: It is the number of pressure change revolution in unit of time. It is generally measured with “revolution per minute”.

Pressure Change Revolution: It is the part between two successive points on which pressure reaches the same level (approaching from the same direction)

Pure Sound: The sound, which is created by simple harmonic sound pressure change, is identified as pure sound (pure tone)

Periodic Sound: They are non-harmonic sounds that are originated from mergence of two or more pure sounds which are from different frequency.

Equivalent Sound (Noise) Level : It is a noise scale in dBA unit which gives average value of sound pressure or sound energy that constitutes durableness in a duration. Its symbol is $L_{eq.}$

It is evaluated as below;

$L_{eq}= 10\text{Log}_{10}[\frac{1}{n}\sum_{i=1}^{n} 10^{Li/10}]$…………………..(2.1)

Here;

Leq : Equivalent Sound Level, dB(A)

n : Sound number

Li : measured sound pressure level in i'st centre frequency, dB

If more than one noise source is found in the same environment, the total noise level can be determined using the noise curve given in Figure 2.1.

Figure 2.1 Noise curve chart [7]

For instance: In order to contribute to dawn on logarithmic quality of decibel [24];

<u>The same melody;</u>

two guitars' playing instead of one guitar causes a 3 dB(A) increase,

five guitars' playing instead of one guitar causes a 7 dB(A) increase, a hundred guitars' playing instead of one guitar causes a 20 dB(A) increase.

According to the graph shown in Figure 2.1 the difference between the two noise sources is added to the larger one to obtain the total noise level.

<u>If two machines with one 84 dB(A) noise level other than 80 dB(A) operate in the same environment;</u>

Since the noise level difference between them is 4 dB(A), the total noise amount is found as 84 + 1,5 = 85,5 dB(A) by adding to the big noise level which is 1,5 dB(A) which corresponds to the 4 dB(A) difference in the noise curve graph.

<u>If four noisy machines in the same enviroment respectively, 80 dB(A), 80 dB(A), 80 dB(A) and 80 dB(A);</u>

we must group the noise levels by two;

group one: 80 dB(A) – 80 dB(A) = total noise level is 83 dB(A) by graph

group two: 80 dB(A) – 80 dB(A) = total noise level is 83 dB(A) by graph

and 83 dB(A) – 83 dB(A) = <u>total noise level of same environment 86 dB(A)</u>

Daily Noise Exposition Level ($L_{EX,\,8hours}$) As identified in the standarts of TS 2607 ISO 1999; It states the time nominal average of all the noise exposition levels in which instant pulsed noise is included, as well for a eight hours working day [37].

$L_{EX,8Saat} = L_{p,A,eqTe} + 10\log(T_e / T_0)$ dB…………(2.2)

It is evaluated in this way;

L_{Aeq}: Total exposition level of a nominal sound pressure
T_e: Total exposition time in evaluation of noise exposition
T_0: The eight hours period in evaluation of noise exposition.It states.

Lowest Exposition Action Value: According to the regulation, these values are 80 dB(A). The employer at the workplace has to keep headphones and other protective equipment if there is noise at this level [34].

Upper Exposition Action Value: t is the value determined as 85 dB(A) according to the regulation. Employers are obliged to distribute ear protectors if there is noise at this level. The worker also has to wear a headset [34].

Exposition Limit Value: It is the value determined as 87 dB(A) according to the regulation. The weekly noise exposure value can not exceed this value [34].

Maximum Sound Level = Peak Level = Upper Level: The highest value which is possessed by changing noise according to time.

Noise Controlling: It is the elimination or optimization process of detrimental effects of sounds, which possess the character of noise spreading from any sound source, with some methods like optimizating to an acceptable rate, changing acoustic feature, decreasing action time, masking with pleasant or another less disturbing sound. Noise controlling can be done in three elements as in noise source, environment of noise and on user affected by noise.

Sound Transfer Coefficient = Sound Transition Coefficient = Sound Transmission Coefficient: Sound transfer coefficient, what is basic unit in measurement of a construction element's sound insulation, takes the name sound transfer loss= sound transition loss= sound transmission loss when it is stated in logarithmic scale and sound incoming to the element's surface and sound, which is transmitted to the back side of element, are different from each other. Its unit is decibel. Sound transmission loss are changing according to sound frequency besides element features.

Sound Absorption: It is the conversion of the energy which is formed in a clashing sound vawe to the surface of an element, to heat energy because of attrition on the element's stigmas and it is reduction of sound energy which is back reflected from the surface.

Sound Insulation: It is reduction of transmitted sound volumes with construction elements or in other words it is all of the precautions, which can be taken in components, used materials and element's construction, in order to increase sound transfer loss of the element.

Physical Environment Factors: It is formed in physical environment which sound is transferred from source to user, construction or affected people and it is every kind of element that increase or decrease noise which affect sound propagation.

Threshold of Human Ear's Hearing: A young and healthy human ear hears a 1000 Hz frequency sound as 20 uPa (micropascal) and this value is named as human ear's hearing threshold. This value is also known as 0 dB as shown in Table 2.1.

Human Ear Pain Threshold: Human ear's pain threshold is on the level of 100 Pascal sound pressure. Pain threshold can be different from one individual to another. Pain threshold changes between 120-140 dB(A) as noise volume as well.

Sound Frequency Range That Human Ear Can Hear: A young and healthy human ear can hear the sounds between 20 Hertz and 20.000 Hertz frequency. Sounds that are below this range are identified as infrasound, which are upper ones are identified as ultrasound.

Noise Measurement: It is measured with "Dosimetry" devices that are developed according to noise features. Noise measurements are done according to related standarts of TSE.

<u>Secured Noise Measurement Rules </u>[39];

● The batteries of measurement devices should be checked beforehand.
● Device should be calibrated before and after measurement.
● The type, number etc of used device should be noted.
● The atmospheric features of measurement area should be specified (temperature, humidity rate, wind speed and direction)
● A plan of measurement area should be created, measurement points, reflectors and absorbing surfaces should be marked on the plan.
● If a noise source's noise level is measured; before the source works, the back ground noise of measurement point should be measured.
● Accurate settings should be chosen according to the device's features and the type of noise.

The Connection Between Noise and Distance: The more distance to sound source increases, the more sound volume decreases and the more the distance decreases, the more sound volume increases [36].

Example, noise level from the source:

If sound level is far from source 1 meter, it will be 100 dB(A)
If sound level is far from source 2 meter, it will be 94 dB(A)
If sound level is far from source 4 meter, it will be 88 dB(A)

2.3 Types of Noise

It is depended on sound's frequency spectrum, time- varying of sound level and environment to which sound spreads [39].

<u>I.Types of Noise According to Frequency Spectrum</u>

<u>a. Perpetual Broadband Noise</u>

Several noises have a perpetual spectrum. In a word; the frequency of sound that create noise, expands during the whole frequency. The mixture of all the colours that are formed in the nature, gives white light, perpetual spectrum sounds which possess all of the frequency ranges, creates "White Noise" as well. The best example of white noise is machine noise [39].

<u>b. Perpetual Narrow Band Noise</u>

A few frequency take part in this kind of sounds. For example; cold saw's sound constitutes especially high frequency and takes part in this branch [39].

<u>II. Types of Noise as Related to Time</u>

Noises, which have significant changes in noise level during investigation, are named as instable noise. Instable noises are divided into three groups in themselves [39].

a. Flowing Noise: They are noises which have perpetual and significant changes in the level during investigation.

b. Intermittent Noise: It is the noise whose level decreases to environment noise level in a minute and whose value on environment noise level goes stable for one second or more. Traffic noise and ventilators which stop and rerun are the best examples of this type of noise.

c. Impact Noise (Instant Noise): It is the noise which continues less than a second and which is created by impacts more than one. The best examples of this noise are hammer and riveting machine's noise.

2.4 The Effects of Noise on Human Health

Negative effects of noise on human health have importance as much as air pollution, water pollution. Because noise is a very important environmental pollution which affects people's hearing and sense negatively, and which can ruin people's psychological and physiological balances, and which decreases productivity, and which change the quality of environment by demolishing its beauty and calmness. But there is no financial pollution, poisoning or burning of any being because of noise [40].

The most visible effect of noise is its being cause of hearing sense loss. (Güner, 2000). Perpetual and high volumed noise not only causes disorders about hearing, but it also causes a lotof negative effects just like listening and understanding difficulty, decrease in concentration and work quality, irregular sleep, irritability and dizziness, this is clarified scientifically. It is possible to array these effects below [40, 41, 42];

It disturbs people,

-It decreases resistance against immune system,

-It has negative effects on reproduction,

-It blocks verbal communication pretty much,

-It decreases work activity and it blocks thinking,

-Works about memory, works to learn new words are negatively affected from noise,

-It creates disturbance in sleep and it makes it difficult to fall a sleep,

-It causes behavior disorders just like being angry, getting excited etc.

-It can cause character change on people and it can cause problems' and anxiety's becoming harder with inclined ones,

-It has detractive effect on the reading, understanding and learning level and action,

-It negatively affects problem solving ability.

The impact of noise on human health is different from one to another person. Sounds whose volumes are more than 60 dB(A) and which spreads to working area disturb employees in various ways. The more sound's volume increases, the more negative effects increases. Business pay almost no attention to noise issue as the outpouring period of these effects takes long time. Because of this reason, occupational diseases related to noise are the most common occupational diseas in our country's industry. Negative effect of noise on human clears away after taking a rest for some time. But the time is so long. For example; in order to eliminate a 18-20 dB(A) volumed temporary hearing loss which is formed on an employee working in an area more than 90 dB(A) presents for 100 minutes, employee should keep away this area for 1000 minutes. So, necessary time to prevent temporary hearing loss is ten times of time elapsed in noisy environment. Besides, the more noise level increases, the more hearing loss increase. In this situaiton, much more time is needed to get better [43].

2.4.1 Physical Effects

Deafness is the leading of damages which are given by noise to human health. Deafness can be split into two groups as temporary deafness and permanent deafness. Permanent deafness; if a person is suspended from noisy environment and if any recovery is not seen on his/her hearing, it can be specified as permanent deafness. First deafness symptoms are seen on 4 kHz [44]. The main reason of this is that external ear and ear canal pass to resonance between 2000-4000 Hz and this increases sound pressure level 20 dB(A). If this situation takes a few hours, temporary hearing loss happens. If presenting at a noisy environment takes during years, temporary hearing loss in human is transformed to permanent hearing loss.transient hearing loss-permanent hearing loss-the relationship between sound pressure and frequency is shown in Figure 2.2

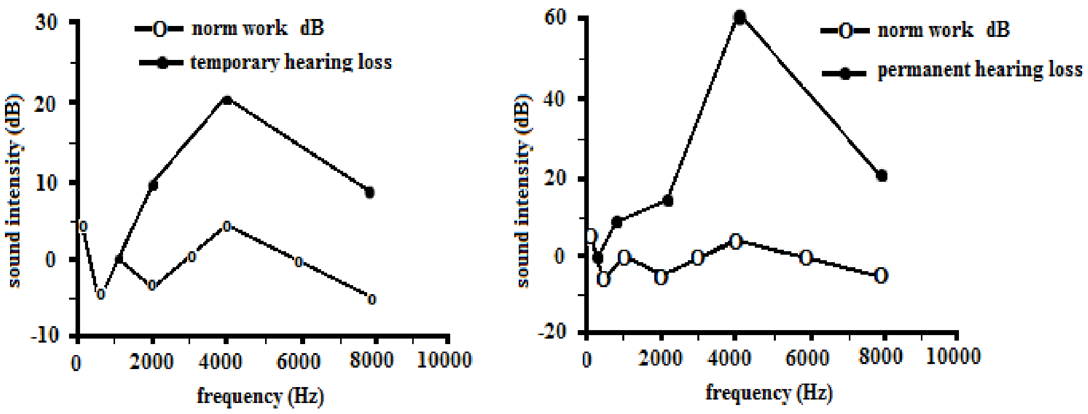

Figure 2.2 Transient hearing loss-permanent hearing loss-relationship between sound pressure and frequency

Hearing damages can generally split into three stages depended on the volume of noise, perpetuality/ intermmittence of noise, age and total time elapsed in noisy environment, sensibility to noise and physiological situation in the body [45].

I. stage: hearing deficiency begins because of high frequency, but disease can be recovered totatlly,

II.stage: It is formed on people who work in noisy enviroment for 2-20 years. In this situation, individual is not aware of hearing disorder but he/she can not hear whisper from 2-3 meters,

III.stage: hearing deficiency is realized, in this situation individual can hear high volumed sounds near him/her. Temporary or permanent hearing loss formed on individuals who are exposed to long duration high volumed noise or who are exposed to sounds that are above 87 dB(A).

*Temporary Hearing Loss;*They are hearing loss that can be recovered after resting for a time.

*Permanent Hearing Loss;*It is impossible that people, who work in noisy environments, possess necessary recovery periods in especially industry.

Audiogram: It is the result of hearing test.

2.4.2 Psychological Effects

Psycological diseases are seen with almost all of the people, who are exposed to noise, in scientific studies. The clearest provision of living in noisy areas is identified as “annoyance”, it is the feeling of distress and tension. If noise is high enough, its source is not certain and the distress it causes is much enough, following behavior disorders can be seen [45]:

- Sudden fulmination, inability to control anger and loosing oneself etc. There are excessive behaviors which are originated from noise, in our country’s newspaper and police records as so in various countries and especially these behaviors can vary to commit a murder against the ones who make noise
- self-reproach, excessive silence and autism
- bring disputant and pessimist
- Increase in sleeping pill consumption
- Tolerance fall
- Decrease in help request.
- Behavior disorders
- Blaze
- Disturbance feeling
- Getting bored
- Visiting her/his doctor, closing the window, spending less time outside or writing articles which state her/his complaint.

2.5 Effects of Noise on Performance

It has been researched that how people’s performance (productivity) are affected from the noise they are exposed in their house, workplaces and during various activities. Noise decreases work power productivity of professionals up to 60% and productivity of manual workers up to 30% [40, 46].

The most significant performance effects are these:

- Influence of dual conversation
- Listening and understanding difficulty shows up
- Speaking is cut.
- Speaking in high voice is needed

- Human communication is spoiled.
- Telephone calls are affected.
- Listening to radio, Tv and music is affected.
- Reading and learning are affected negatively.
- Influence of concentration
- Influence of teachers.
- Influence of work performance.
- High level, sudden or discontinuous noises can affect work productivity variosly in work life.
- Doing a work timely.
- Doing the work properly.
- Occupational accidents.

2.6 Effects of Noise to Enviroment

Noise has impacts on both physical and social environment. These impacts are stated below [45].

2.6.1 The Effects of Noise to Physical Enviroment

Focusing on light rail system in city and providing entegration of these to each other and limitating road traffic in problematic parts will provide allayment in terms of environmental problems. Construction of metro lines underground completely, construction of light rail system underground partly provides significant advantages in terms of environmental impacts. There are some clear negative impact of rail systems, the most important one is their passing throug or near residental area. Necessary precautions should be taken and noise maps should be prepared in this type of places. High sound volume and shock waves are formed during various mining activities in the atmosphere all around our country. This creates quake into the ground and affects near buildings. Because of those, its effect on physical environment is seen [45].

Noise sources should be related to noise sensitive areas in construction plan and buffer zones should be constructed between construction area and the roads, on which vehicles pass in transit, in construction plan as a precaution. The vehicles' noises should be absorbed by planting of these buffer zones with proper plants and tree kinds. Small industrial business in the city should be moved to industrial area. Plantng of these should be sustained. Especially Organized Industrial Zones and factories' environment should be planted [47]. Noise levels in some areas of the environment are also shown Table 2.2.

Table 2.2 Noise levels in some areas of the environment [45]

Usage Area	Sound Pressure Level (daytime) dB(A)
Resting Areas	
Theatre Halls	25
Conference Halls	30
Hotel Bedrooms	30
Hotel restaurants	35
Healthcare Constructions	
Hospitals	35
Residences	
Bedrooms	35
Sitting rooms	60
Service parts (kitchen,bathroom)	70
Educational Constructions	
Classrooms, Laboratories	45
Sport Centers, Dining Halls	60
Industrial Constructions	
Factories (small)	70
Factories (big)	80

2.6.2 The Effects of Noise to Social Environment

Studies, which are made on patients who receive a treatment in both noisy and resident hospitals, proved that patients should stay more for a treatment in the hospitals which are exposed to either internal or external noise. This reveals the cost of noise monetarily. Along with this, the evaluation of taken sleeping pills and expenses which are spent on isolation for apartments, is pretty difficult. Besides, the impacts of noise on work standarts is difficult, as well. However, this difficulty does not affect the presence of problem. It is a reality that noise has spiritual depression impacts on people [45].

2.7 Industrial Noise

Noise which are originated from industrial activities disturbs employees working at this workplace. Some measurements in various workplaces are shown on Table 2.3.

Table 2.3 Measurements in various industrial [45]

Workplaces	Noise Level dB(A)
Lumber mill	102,5
Casting Plant	96,5
Machine tool andspare part factory	99
Monopoly, cigarette factory	101
Newspaper factory	100,5
Shoe factory	104,5
Medicine and industrial phases factory	98
Automobile factory	97,7

2.8 Regulations about Noise

2.8.1 National Legislation

Regulations which are related to noise are stated in "*Regulation About Employees Protection From Risks About Noise"* which is effectuated by promulgating on *28.07.2013* dated and *28721 no. Official Gazette*. exposition action values, Exposition limit values are shown on Table 2.4.

Table 2.4 Exposition action and limit values stated in the regulation on works with noise [34]

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

Besides, employer provides the controllability of risks in their sources, and decreasing the risk to the minimum or effacing of risks originated from exposition of noise by considering technical developments as related to preventing or decreasing of exposition, and employer designates how precautions will be taken according to 8th, 9th, 10th and 11th articles.

The provisions of "*Mine works related to ore mining like galena, cerussite, anglesite and in which bullet are produced and works whose noise level is more than the highest exposition value (8h=85 dB(A))*" exist in the fourth article of "*Regulation About the Works on which employees should work seven and half hours maximum or* *less in terms of health rules"* which was effectuated by promulgating in *16.07.2013* dated and *28709 no. Offical gazette*. Maximum working hour is specified as 7.5 hours at this workplaces.

The number of employee, who got occupational diseases originated from noise according to 2016 datas of Social Security Institution in our country, is given on Table 2.5.

Table 2.5 The number of employee, who got occupational diseases originated from noise according to 2016 datas of Social Security Institution

DIAGNOSTIC SUBGROUP	The Number of Social Insurant Who Got Occupational Disease	
H2 Group Ear and Mastoid Process Diseases	**Male**	**Female**
H83.3 Noise effects in inner ear	6	0
TOTAL	**6**	

Exposition and obligation periods in noisy works according to *"Social Security Health Procedures Rule"*;
In order to evaluate noise damages as occupational diseases, employee should work at noisy works at least two years, and he/ she should work at works, whose noise level is continuosly more than 85 decibel, at least 30 days. Obligation period is stated as 6 months.

2.8.2 International Legislation

The values, belonging to the relation between noise level and working duration according to ILO's standarts, are expressed on Table 2.6. Given values are valid in the situations if noise is continuous or discontinuous. It is not applied onexplosion and pulsed noises.

Table 2.6 Maximum working hours related to noise level [48]

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

Daily noise exposition limit values, which are specified by international institues, are given on Table 2.7.

Table 2.7 Noise exposition limit values in international regulations [49,50,51,52]

<table>
<tr><td rowspan="3">England Occupational Health and Security Organization (HSE)</td><td>Lowest Exposition Action Values</td><td>80 dB(A)</td><td>135 dB(C)</td></tr>
<tr><td>Upper Exposition Action Values</td><td>85 dB(A)</td><td>137 dB(C)</td></tr>
<tr><td>8 Hours Exposition Limit Valuess</td><td>87 dB(A)</td><td>140 dB(C)</td></tr>
<tr><td>Occupational Health and Safety Organization of America (OSHA)</td><td>8 Hours Exposition Value</td><td>90 dB(A)</td><td>-</td></tr>
<tr><td>American National Institute of Occupational Health and Safety (NIOSH)</td><td>8 Hours Exposition Value</td><td>85 dB(A)</td><td>-</td></tr>
<tr><td>Canada Centre of Occupational Health and Safety (CCOHS)</td><td>8 Hours Exposition Value</td><td>87 dB(A)</td><td>-</td></tr>
</table>

2.9 Noise in Textile Workings

Noise is an important parameter in terms of occupational health and safety especially in workplaces in which noisy weaving, knitting and yarn spinning machines work in textile sector. Because of this reason, checking the noise exposition level of employees, working at this kind of workplaces, is so significant. When the noise levels of some textile business on Table 2.8 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 2.8 Noise levels of textile departments of fabrics [8]

Department	Noise Level
Blowroom – Carding – Draw Frame - Combed	80-85 dB(A)
Roving Frame – Ring Spinning Yarn	85-93 dB(A)
Weaving Preparatory, Sizing and Weaving Draft	80-85 dB(A)
Yarn Twist – Doubling	95-105 dB(A)
Knitting	80-85 dB(A)
Weaving	93-100 dB(A)
Dyeing	80-85 dB(A)

When the table above is examined, weaving, yarn twisting - doubling and cord-vater departments are the highest noisy parts in textile business. Because of this reason, it is shown up that these departments are the most important ones in terms of noise check and working employee sensitivity.

Some important protection precautions taken against risks originated from noise in textile business are specified on Table 2.9.

Table 2.9 Important protection precautions taken against risks originated from noise in textile business

Resource Oriented Protection Implementations	
Elimination	Removing machine or process that cause noise from workplace environment if it is possible.
Substitution	Exchanging machine or process that originate noise with a noise free or less noisy machine or process if it is possible.
Technical Precautions	Reducing the noise which is originated from machine with proper sound absorber- sound reducer scientific methods and engineering implementations in order to reduce noise level in resource.
Environment Oriented Protection Implementations	
Isolation	Seperating noise source from the environment. For example, seperating air table compressor from working area by wrapping it with soundproof material in carpet weaving business.
Organizational Implementations	Increasing of distance between noise source and employees, wrapping working environment with sound absorber materials, using sound breakers in proper places at working environment, planning noisy machines' places in the way noise does not gather at the same point, getting measurement of personal exposition done, putting proper warning signals, planning work period as the shortest in noisy works.
Personal Protective Equipments	
Giving proper ear protectors to reduce noise effect, providing usage of them and inspection. The relation between noise level and usage of ear protectors; - 80 dB(A): ear protector equipment should be kept for employee's usage. - 85 dB(A): Employee should provide usage of ear protector equipments by employees and he/she should inspect this. - 87 dB(A): Necessary precautions should be taken in order to reduce below limit value	

Employee has to keep ear protector equipments, employee has to provide usage of these equipments and inspect them when it is necessary according to *"Regulation Related to Protection of Employees from Risks About Noise"*.

There are some points to be considered about ear protector equipments, which constitutes the most importance, in terms of occupational health and safety in order not to cause other risks.

These are below;

- Ear protector should be chosen suitable to work and noise level
- A healthy headset that will not cause an extra reaction should be chosen
- It should be fitting to ear properly
- It should be changed when it is deformed or its elasticity is spoiled
- Cleanliness of ears should be considered especially

The noise protection effect of ear protectors is pretty high. As seen on Table 2.10 about usage time, the more usage period increases, there is a serious decibel decrease like 30 dB(A). This situaiton reveals the importance of ear protectors in noisy works.

As hearing loss in noisy jobs occurs at most 4 kHz, ear protectors provide the best protection at this level. As a result, workers who work in a very noisy place with ear protector can chat freely, ears are protected from noise. Talk frequency is between 250 Hz and 1000 Hz.

Table 2.10 The decrease in ear protectors' efficiency [53]

Percantage of Usage (Time)	Maximum Protection Level
50%	3 dB(A)
60%	4 dB(A)
70%	5 dB(A)
80%	7 dB(A)
90%	10 dB(A)
95%	13 dB(A)
99%	20 dB(A)
99,9%	30 dB(A)

Ear protector and noise reduction rates:

You should pay attention to some special values when choosing ear protector [54];

NRR (Noise Reduction Rating): It is an evaluation system developed to provide some rules about the potential protection that noise suppressors will provide in a noisy environment. NRR is measured in laboratory conditions and is given as a number of NRR in dB. The high number indicates that protection is also high. The actual protection provided by the noise suppressors is less than ideal or measured value. The NRR is assumed to be less than seven dB (5-10 dB). In other words, proper noise suppressors can reduce the employee's exposure to noise (NRR-7) dB (A).

NRR is subtracted from the measured dB (C) at the workplace to detect the noise experienced by a person using the noise suppressor.

dB(A) = dB(C) – NRR can be represented by formül

<u>SNR (Simplified Noise Rating – Single Number Rating):</u> It is part of the evaluation system established by the European Union (EU) for sound suppression. The tests are carried out by commercial laboratories independently of the manufacturers. SNR, such as NRR, are also expressed in dB(A) and used as a guide to compare the potential noise reduction capacities of different noise suppressors. Since the methods of measuring NRR and SNR are different, the values of a certain noise suppressor are also different. For example, the NRR value for a eaar protector can be 27 dB(A) and the SNR value can be 30 dB(A).

CHAPTER 3

LITERATURE SURVEY

3.1 Literature Survey

Some important studies about the topic are mentioned chronogically below;

Vatandaş and friends (2000), examined the measurement and evaluation methods of noise and sound by concentrating on physical features of noise and sound. Precautions which can be taken to control noise with noise standarts and noise's effects on human health are clarified [55].

Şahin (2003b), researched the impacts of noise on production and productivity and it was stated that taken noise control precautions have impacts on time and quantity parameters in production. It was stated in the study that taking noise under control in work will affect the employees' production performance positively [56].

Wachasunder (2004) examined the impacts of noise levels on employees in oil rafineries. It was observed that some operations in oil refineries exceeds 90 dB(A) and they affect environment. On the consequence of examinations, it was stated that hearing problems are caused largely from noise exposition and employees' ages [57].

Ege (2004), made sound level measurements and equivalent sound level measurements in 4 textile business, 4 weaving and 2 yarn department with 1/1 octave band centerfrequency in the study. The results were examined with frequency analysis. It was determined that noise levels, which are formed in frequency analysis, constitute noise factor for weaving and yarn departments, especially noise level in weaving departments is above 90 dB(A) what is specified by international standarts organization (ISO) for a 8 hoursworking [58].

İlgürel and Sözen (2005), It was stated that trying to reduce noise level in production places have importance on the protection of employees from the noise and on working conditions' becoming appropriate and this was seen by the results of questionnaire related to habits of using personal protector and disturbance of employees from noise at various industrial work places [59].

Özel (2006), emphasize on basic concepts about sound and noise and used measurements in the evaluation of noise in the study. It was determined how noise is a big problem in work places. And it was proved in there search that noise level of textile factories is 96,4 dB(A) and working with out protection is unfavorable in terms of employees' health [60].

Hayta (2007), expressed the concepts which affect employee's health, safety and productivity in work. It was stated that assignment of employees in the works on which they can work healthy and safely according to physiological and pyschological criterias and determining of proper environment conditions (temperature, humidity, ventilation, noise, vibration etc.) can create desired productivity by increasing quality and quantity of production. Noise impacts, percentage of business loss depending on noise level and endurance time to noise were clarified [61].

Sağbaş and friends (2008), researched the most efficient and economic method to reduce noise in textile business and it was determined that this method is to isolate sound on machine sand it is made by mounting noise reduce requipments to air conditioners and ventilation equipments and this method is named as protective covering method [62].

İçin (2011), noise levels which are exposed by employees who work in agriculture based flour, bait and oil business, were determined, besides, it was stated that noise level in the department of mill, elimination and cleansing in flour business exceeds the danger level and working more than 4 hours should not be permitted. As to dissolution department working more than7,5 hours should not be permitted. It was also stated that there is noise level that can affect human health negatively in bait business. As for oil business, it was determined that crushing-grind and elimination-cleansing departments exceeds noise level limit value this is why working in crushing-gring department more than 2 hours and working in elimination and cleansing departments more than 4 hours should not be permitted [39].

Değer (2015), made a study about noise exposition in 10 wood work workplaces that he/she selects in the thesis. On the consequence of measurements which he/she made according to TS EN ISO 9612:2009 standarts, he/she found the average noise level of some departments in work places. These are; in the cutting process with band saw 90 dB(A), in the punching with drill process 86,33 dB(A), in the grating process 91,92 dB(A), in the millin gprocess 89,09 dB(A), in the cutting process with horizanta circular saw 88,99 dB(A) and in the sanding process 89,94 dB(A). It was stated that employees should not be worked more than 7,5 hours in these work places and Değer makes suggestions to decrease noise exposition in his/her study [63].

Kadiroğulları (2016), revealed that noise constitutes risks like occupational disease, occupational accidents, decreasing of work performance and the leading of these risks hearing loss. And 80% of measurement values' result revealed the presence of noise exposition'sre sults in the study [64].

Konuklar (2016), made studies about personal noise exposition by making measurements according to TS EN ISO 9612 2009 standarts in total 11 weaving factories as 8 fabric and towel weaving factories and 3 carpet weaving factories. Konuklar found out personal exposition averages in fabric and towel weaving factories as 94,06 dB(A) and in carpet weaving factories as 86,6 dB(A). Konuklar compared these found values with ceiling height and distance between machines, and in the consequence of this comparing he stated that the more ceiling height and the distance between machines increase, the more noise exposition decrease [65].

CHAPTER 4

MATERIAL AND METHOD

4.1 Material

5 pieces of carpet weaving factories operating in Gaziantep Organize Industrial Zone selected as a material to make noise measurement at carpet companies in textile sector.

4.1.1 Measured Factories

Generally those factories are similar but as it seen in the Table 4.1; number of carpet weaving machine, process, number of employe has different quality in terms of capacity.

Table 4.1 Some properties about measured factories

Qualification of factories	**Factory 1**	**Factory 2**	**Factory 3**	**Factory 4**	**Factory 5**
Number of weavingMachines	3	18	15	11	8
Number of personnel	67	600	251	200	150
Capacity (m^2/month)	55000	250000	170000	120000	90000

The companies which make noise measurement has smilarities in shape of process and good producing. The differences between companies is 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 companies, to measure of noise level which occured in working environment of employees, measure of individual exposures temming from noise made by bearing in mind that appropriate measure Standard method.

The aim here is determine the ambien tnoise and at the same time the level of exposed to noise level then reveal the differences between those two test value.

4.1.2 Device Used For Noise Measurement and Specifications

4.1.2.1 Working Field Noise Measurement Device

Cesva/sc310 the device used for noise measurement is the first class noise measurement device. It can be expanded according to 1/3 octave banded spectrum analyzers. The device contains all function to calculate basic index forequi valent level, percentage, peak level sand noise exposure levels, acoustice valuation in most countries in the world [66].

Figure 4.1 Working field noise measurement device

4.1.2.2 Calibrator of Working Field Noise Measurement Device

The used calibrator is the model of CESVA/CB006. It is used for calibrate the noise measurement device at laboratory or at the area of measuring area. It is the first class portable device that produced according to IEC 2003. There is no need use the static pressure and heat application when this device used [67].

Sound pressure level: 94 dB re 20 μPa (1 Pa = 1 N/m2)   Warp: < 2%

Working humidity: between: 25% - 90%   frequency: 1 kHz ± 1%

Figure 4.2 Working field noise measurement calibrator

4.1.2.3 Individual Noise Exposure Measurement Device

The device of measurement used for individual noise exposure is the model of QUEST 3M/EDGE 5. It is made of lithium polymer raw material and the first class device. It is certified IEC 61252 and conformity for ANSI S1.25 and CE Standart. It's usage doesn't distrub the employee [68].

Figure 4.3 Individual noise exposure measurement device

4.1.2.4 Calibrator of Individual Noise Exposure Measurement Device

The calibrator device which used for the accuracy of measurement device at the working area is model of QUEST 3M/ QC 20. It measure faster and more sensitive comparing to other calibrators. It has the specifications of producing a 114 dB constant noise level at the point of 1000 Hz constant frequency. This calibrator certified IEC and ANSI [69].

Figure 4.4 Individual noise exposure measurement device calibrator

4.2 Method

4.2.1 Measurement Method

Within the scope of this study, determine the working environment noise level and examine the individual noise exposure stated carpet companies is made in accordance with standards. Accordingly;

For individual daily noise exposure, "*TS EN ISO 9612:2009 Acoustics -- Determination of occupational noise exposure – Engineering method*" used method for preparing appropriate standard.

4.2.2 Noise Measurement According to TS EN ISO 9612:2009 Standard

The Standard used: It is used for explain measuring method of determine the occupational noise exposure level.

The implementation steps of the Standard are given below [68];

- Work analysis
- Choice of measurement strategy
- Perform measurement
- Review of the uncertainty and sources of mistake
- Calculating and submit the result

► *<u>Work Analysis:</u>*

Analysis is should be measure up work and information abaout employes. Productive measurement strategy can be chosen by these information and measurements can be planned. Work analysis is required that measurement is to be performed in all situation.

This procedure [70]:

- Determine operations of companies by consideringly of employes' work
- If possible determine the areas that will cause homogeneous noise exposure
- Determine a nominal day or days forever yemployes
- Determine the tasks which constitutive work
- Detect high-level noise event that are likely to occur
- Decide the measurement strategy
- Ensure the necessary information to generate measurement plan

Work is analyse in defiance of producing, process, organization, employes and operations. In the event measurement can be made by task based, job-based or full-day strategy. Even which ever follow-up chosen, to name all important events in terms of exposure to noise and to ensure that they participate in the measurement plan [70].

<u>Identify homogeneus noise exposure groups;</u>

Time spent and make effort for the measurement can be decrease by grouping homogeneus noise exposure [71]. Employes to be included in this group consist of persons who has the same work and are thought to have been exposed to smiliar noise during the work day. This group can be consist of one employe or more than one employe. Homogeneus noise exposure group can also be named as smiliar noise exposure.

►*Choosing measurement strategy:*

There are more than one factor in identifying the measurement strategy. Those factors are like the aim of measurement, complication of work situation, how many employe are necessary, effective time of work day, avaliable hours and how much informaiton needed for measurement and analysis. Measurement follow-up should be chosen in task-based measurement, work-based measurement or full-day measurement [70].

• Task-based measurement: operations analyses during the work-day and some parts splitted up as a task and noise pressure level is for each task

• Work-based measurement: especially noise pressure level sample is taken during the business carried on.

• Full-day measurement: voice pressure level is measured in whole day continuous.

►*Measurements*

Pursue a task-based measurement strategy in this study.

Task-based measurement:

Nominal day divided to tasks for the step of workers or homogeneus noise exposure groups. All item which subscriber to noise is take in consideration. Task duration is determined by employes and responsibles. Alternatively for determine the time interval more than one employe and responsibles are consulted. 3 measurement is being at least 5 minute for each task [70].

Measurement results recorded in device with a name which determined or automatically as signed by a device. Obtained datas connect with a patch cord in to a computer which used software loaded computer to transfer all data to computer environment. Needed calculating is done and results are reported by constituted calculate programs.

Position of individual exposure measurement device is 0,1 meter far from in ear canal and 0,04 meter above of shoulder [72]. In factories, before the noise measurement and after, the noise measurement, noise measurement device calibrated with noise calibration device twice from the point of accuracy of measurement. Measurement is made by noise measurement device is positioned in 1 meter distance from the noise source.

The measured values are compared with 85 dB(A) which is accepted upper action value and 87 dB(A) which is 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 seperate graphics and tables.

CHAPTER 5

RESULT AND DISCUSSION

In this section, within the 5 identified carpet factories, personal noise exposure measurements were made on both the workplace environment measurements and the workers working in noisy areas. Since is no regulation on environmental measurements in the legislation, no assessment has been made but personal noise exposure measurements are compared with the action values and limit values specified in the legislation’s regulation.

Environmental measurements in work areas and personal noise exposure measurements 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.

5.1 Noise Measurements Made at Factories

Noise measurements were made in the most intensive work areas in the factories. In the areas which noise levels were measured as high noisy, the personal noise exposure measurements were evaluated. As mentioned earlier, ambient noise measurements were made in order to compare the personal noise exposure measurements, which are essential in the noise level and which are essential in the regulation.

5.1.1 Noise Measurements of Factory 1

As stated in Table 4.1, Factory 1 is the smallest factory in terms of weaving machine, number of employees and capacity. The noise ambient measurement values of the Factory 1 are shown in Table 5.1.

Table 5.1 Noise ambient measurements of Factory 1

No	Place of Measurement	Measured Value L_{eq}dB(A)
1	No. 1 Weaving Machine Working Area	82,6
2	No. 2 Weaving Machine Working Area	83,7
3	No. 3 Weaving Machine Working Area	83
4	No. 1 Weaving Machine Cave Working Area	76,1
5	No. 2 Weaving Machine Cave Working Area	78,4
6	No. 3 Weaving Machine Cave Working Area	77
7	Engraving Machine Working Area	75,7
8	Automation Machine Working Area	78,7
9	Carpet Back Coating Working Area	74,8
10	Pneumatic Table Working Area	71,9
11	Roll Bending Machine Working Area	75,2
12	Band Cutting Department Working Area	80,5
13	Band Bonding Department Working Area	71,7
14	Band Sewing Department Working Area	72,3
15	Band Twist Section Working Area	71,8
16	Lark Apre Department Working Area	75,6
17	Chitty Machine Working Area	69,3
18	Bobbin Transfer Machine Working Area	72,8
19	Label Makinesi Working Area	71
20	Shrink Machine Working Area	81,6

According to the ambient noise measurement results shown in Table 5.1 of the working areas; the most noisy working area in the enterprise is the working areas of weaving machines. However, the noise level is also measured in the band cutting section working area and in the shrink machine working area. It has been determined that the working area with the lowest noise level is the working area of the chitty machine.

The personal noise exposure measurement values of workers in Factory 1 where there is continuous noise exposure and the noise level is considered high are given in Table 5.2.

Table 5.2 Personal noise exposure measurent values of Factory 1

Employee Mission / Work	Measured value within 8 hours $L_{EX,8h}$ dB(A)	The Highest Exposure Action Value dB(A)	Limit Exposure Value dB(A)	Measured value within 8 hours P_{peak} dB (C)	The Highest Exposure Action Value P_{peak} dB(C)	Limit Exposure Value P_{peak} dB(C)
Number 1.Weaving machine	**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

According to the results given in Table 5.2., personal noise exposure 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 5.1 and Table 5.2 are evaluated together both ambient noise and personal noise exposure measurements 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 personal noise exposure is measured; stays close to the source of noise throughout the duration of the action.

5.1.2 Noise Measurements of Factory 2

Another factory where noise measurements are made is Factory 2. This is the factory with the highest machine, worker and capacity levels, as indicated in Table 4.1, among the enterprises surveyed. The noise measurement values for the working environments in Factory 2 are shown in Table 5.3.

Table 5.3 Noise ambient measurements of Factory 2

No	Measured Area	Measured Value L_{eq}dB(A)
1	No.3 Weaving Machine Working Area	84,5
2	No.13 Weaving Machine Working Area	84,6
3	No.6 Weaving Machine Working Area	81,4
4	No.9 Weaving Machine Working Area	83,5
5	No.18 Weaving Machine Working Area	81,9
6	Engraving Machine Working Area	77,2
7	Automation Machine 2-3 Working Area	81
8	Automation Machine 1 Working Area	81,5
9	Carpet Back Coating Working Area	77,4
10	Pneumatic Table Working Area	78,5
11	Apparel Department Edge Cutting Working Area	80,6
12	Apparel Department Washing Working Area	79
13	Apparel Department Chitty Working Area	71,6
14	Apparel Department (Carpet Wrapping) Working Area	75,7
15	Apparel Department (Drying) Working Area	81,4
16	Clothing Section Label 1-2 Working Area	77
17	Clothing Section Automatic Bending Machine Working Area	77,1
18	Weaving Department Bobbin Assembly Working Area	81,6
19	Entrance Hall to Administrative Building Offices	79,4
20	Administrative Building - Office Working Area	62,4

According to Table 5.3 the working areas of the weaving machine, the working areas of the automation machines, the winding and drying machine working areas were found to be the highest working areas in terms of noise level.

The personal noise exposure measurement values of workers in Factory 2 where there is continuous noise exposure and the noise level is considered high are given in Table 5.4.

Table 5.4 Personal noise exposure measurent values of Factory 2

Employee Mission / Work	Measured value within 8 hours $L_{EX,8h}$ dB(A)	The Highest Exposure Action Value dB(A)	Limit Exposure Value dB(A)	Measured value within 8 hours P_{peak} dB (C)	The Highest Exposure Action Value P_{peak} dB(C)	Limit Exposure Value P_{peak} dB(C)
1 Number Automation worker	**85,7**	85	87	105,2	137	140
Edge cutting worker	**88,6**	85	87	109	137	140
Pneumatic table worker	**81,9**	85	87	104,4	137	140
18 Number weaving machine worker	**87,6**	85	87	104,1	137	140
Carpet Back Coating worker	**83,2**	85	87	102,5	137	140
Dust absorber machine worker	**85,7**	85	87	108,5	137	140
14 Number weaving machine worker	**88**	85	87	105,1	137	140

When the results given in Table 5.4 the personal noise exposure value of the automation machine worker is greater than the maximum action value of 85 dB (A) specified in the regulation. The average personal noise exposure 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 personal noise exposure generated by the pneumatic table, automation and 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.

5.1.3 Noise Measurements of Factory 3

Factory 3 is second factory with the highest capacity, number of machines and number of workers as shown in Table 4.1 among the mills we have measured. This factory is an integrated mill and produces its own weaving yarn itself in a separate part of the same mill. The noise ambient measurements made in Factory 3 are given in Table 5.5.

Table 5.5 Noise ambient measurements of Factory 3

No	Measured Area	Measured Value L_{eq}dB(A)
1	No.1 Weaving Machine Working Area	88,3
2	No.3 Weaving Machine Working Area	87,9
3	No.5 Weaving Machine Working Area	85,6
4	No.7 Weaving Machine Working Area	85,7
5	No.8 Weaving Machine Working Area	87,3
6	No.9 Weaving Machine Working Area	87,4
7	No.11 Weaving Machine Working Area	89,2
8	No.13 Weaving Machine Working Area	89
9	No.15 Weaving Machine Working Area	86,7
10	Engraving Machine Working Area	82,8
11	Automation Machine Working Area	86,7
12	Carpet Back Coating Working Area	76,3
13	Pneumatic Table Working Area	82,4
14	Sewing Band Working Area	78,8
15	Warping Machine Working Area	78
16	Operation Department of Warp Bobbin Transfer	78,8
17	Shrink Machine Working Area	76,7
18	Carpet Bending Machine Working Area	75,8
19	Roll Bending Machine Working Area	74,7
20	Bobbin Transfer Machine Working Area	82,2

When the ambient noise measurements of the working areas given in Table 5.5 are considered; weaving machine working areas, automation machine working area, air table working area and engraving machine working area are determined as the most noisy areas.

The personal noise exposure measurement values of workers in Factory 3 where there is continuous noise exposure and the noise level is considered high are given in Table 5.6.

Table 5.6 Personal noise exposure measurent values of Factory 3

Employee Mission / Work	Measured value within 8 hours $L_{EX,8h}$ dB(A)	The Highest Exposure Action Value dB(A)	Limit Exposure Value dB(A)	Measured value within 8 hours P_{peak} dB (C)	The Highest Exposure Action Value P_{peak} dB(C)	Limit Exposure Value P_{peak} dB(C)
Automation machine worker	**81**	85	87	90,6	137	140
Carpet back coating machine worker	**70,7**	85	87	89,9	137	140
Weaving machine worker	**89,1**	85	87	96	137	140
Transfer department worker	**81,9**	85	87	99,2	137	140

If we look at the values shown in Table 5.6; the personal noise exposure 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 personal noise exposure 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.

5.1.4 Noise Measurements of Factory 4

When we look at Table 4.1 it is seen that the Factory 4; it is the third biggest mill with respect to the capacity, number of workers and weaving machine.

The noise ambient measurements made in the designated working areas of Factory 4 are shown in Table 5.7.

Table 5.7 Noise ambient measurements of Factory 4

No	Measured Area	Measured Value L_{eq}dB(A)
1	No.1 Weaving Machine Working Area	86
2	No.2 Weaving Machine Working Area	88,3
3	Engraving Machine Working Area	89
4	Automation Machine Working Area	83,5
5	Carpet Back Coating Working Area	79,4
6	Pneumatic Table Working Area	79,2

According to the values given in Table 5.7, weaving machine working environments and carving machine working environments have the highest noise level.

The personal noise exposure measurement values of workers in Factory 4 where there is continuous noise exposure and the noise level is considered high are given in Table 5.8.

Table 5.8 Personal noise exposure measurement values of Factory 4

Employee Mission / Work	Measured value within 8 hours $L_{EX,8h}$ dB(A)	The Highest Exposure Action Value dB(A)	Limit Exposure Value dB(A)	Measured value within 8 hours P_{peak} dB (C)	The Highest Exposure Action Value P_{peak} dB(C)	Limit Exposure Value P_{peak} dB(C)
Number 1Weaving machine worker	**86,5**	85	87	110,5	137	140
Number 2Weaving machine worker	**91,4**	85	87	108,8	137	140
Carpet back coating machine worker	**78,2**	85	87	96	137	140
Engraving area worker	**91,9**	85	87	110,8	137	140
Pneumatic table worker	**82,2**	85	87	100,7	137	140
Automation worker	**81,9**	85	87	101,6	137	140

When the measurement values given in Table 5.8 are considered, we have found that personal noise exposures 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 personal noise exposures 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.

5.1.5 Noise Measurements of Factory 5

Factory 5 is another factory where measurements are made. Looking at the issues shown in Table 4.1, it is the second smallest company in terms of capacity, number of workers and weaving machine. The noise ambient measurements made in the designated working areas of Factory 5 are shown in Table 5.9.

Table 5.9 Noise ambient measurements of Factory 5

No	Measuring Area	Measured Value L_{eq}dB(A)
1	No.4 Weaving Machine Working Area	86,8
2	No.8 Weaving Machine Working Area	87,0
3	No.3 Weaving Machine Working Area	88,9
4	No.2 Weaving Machine Working Area	88,0
5	No.1 Weaving Machine Working Area	86,9
6	No.6 Weaving Machine Working Area	86,5
7	No.7 Weaving Machine Working Area	85,7
8	Engraving Machine Working Area	88,7
9	Automation Machine Working Area	80,5
10	Carpet Back Coating Working Area	79,2
11	Labeling Machine Operating Area	78,4
12	Carpet Wrapping Machine Working Area	71,5

According to noise values measured in working environments; the work areas with the highest noise level were found to be the working environments of weaving machines and the working environment of the engraving machine. The personal noise exposure measurement values of workers in Factory 5 where there is continuous noise exposure and the noise level is considered high are given in Table 5.10.

Table 5.10 Personal noise exposure measurement values of Factory 5

Employee Mission / Work	Measured value within 8 hours $L_{EX,8h}$ dB(A)	The Highest Exposure Action Value dB(A)	Limit Exposure Value dB(A)	Measured value within 8 hours P_{peak} dB (C)	The Highest Exposure Action Value P_{peak} dB(C)	Limit Exposure Value P_{peak} dB(C)
Number 8Weaving machine	**90,8**	85	87	105,5	137	140
Number 4 Weaving machine	**89,99**	85	87	101,4	137	140
Automation worker	**85,7**	85	87	103,1	137	140
Carpet back coating	**77,2**	85	87	101,2	137	140
Engraving worker	**90,1**	85	87	110,6	137	140

When the personal noise exposure values of the workers of Factory 5 which are given Table 5.10; 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 personal noise exposure in the automation machine worker is higher than the highest action value of 85 dB (A) specified in the regulation. According to these results, noise level is seen as a danger for workers of weaving machine, carving machine and automation machine.

5.2 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 personal noise exposure 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 5.1 shows the working area of the weaving machine and weaving machine.

Figure 5.1 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 5.2.

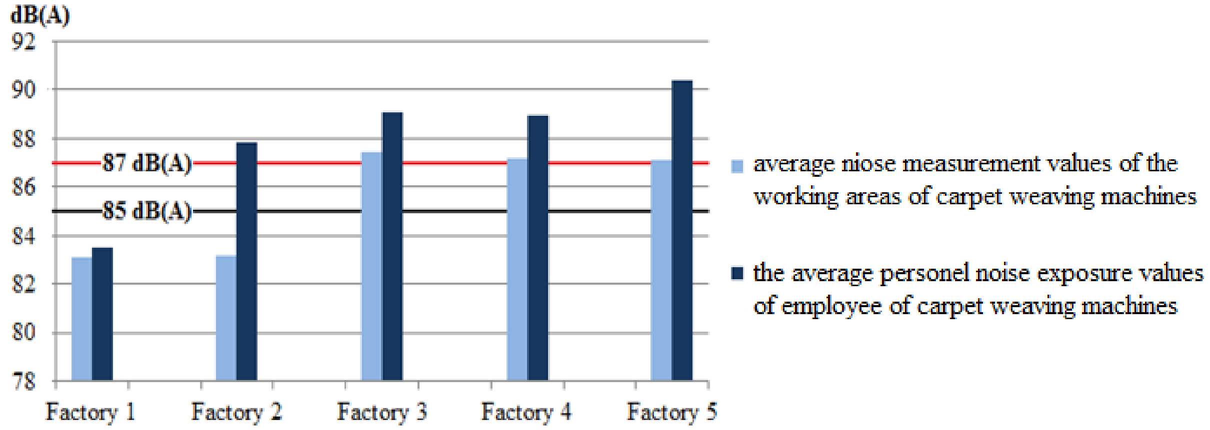

Figure 5.2 Measured personal noise exposure values for workers working in weaving machine and noise ambient measurement in weaving machine working area

As seen in Figure 5.2, it is seen that the personal noise exposure 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 of individual noise exposure values of workers in weaving machines was measured as 88.3 dB (A). The results are consistent with the literature [63]. According to this situation, in carpet weaving factories, there is a high risk of noise for weaving machine workers.

In addition, the noise level average of the weaving work areas and the level of exposure of the weaving workers to noise. shown in Table 5.11.

Table 5.11 Averages of noise levels and noise exposure levels for weaving department

Weaving Machines Working Areas		
Factories	Working Area Noise Values (Average)	Personal Noise Exposure Values (Average)
Factory 1	83,1	83,5
Factory 2	83,2	87,1
Factory 3	87,5	89,1
Factory 4	87,2	89
Factory 5	87,1	90,4

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 5.3 shows the photograph of the engraving machine and operator during operation.

Figure 5.3 Engraving operation and engraving machine working area

As can be understood from Figure 5.3, 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 is given in Figure 5.4.

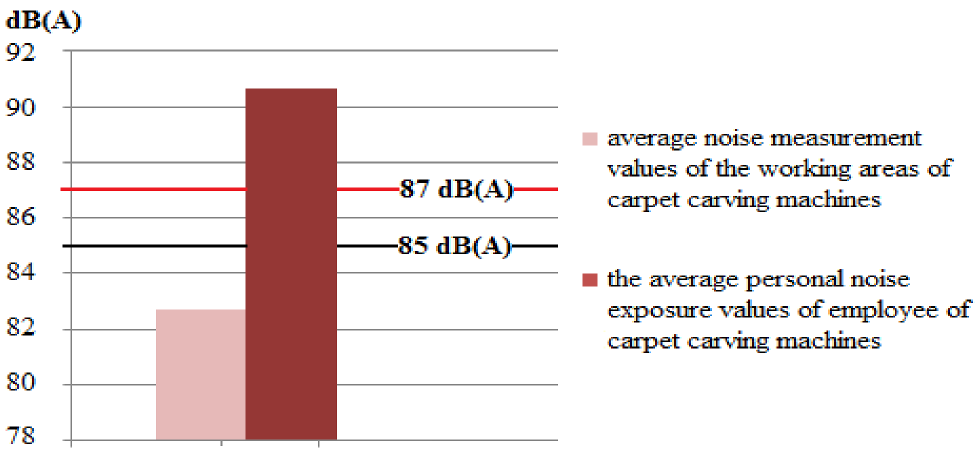

Figure 5.4 Engraving machine work areas average noise level and average noise in workers working in engraving machines personal exposure value

As shown in Figure 5.4, the personal noise exposure measurement results for engraving machine workers are also above the exposure limit value of 87 dB (A).

In addition, the noise level average of the engraving work areas and the level of exposure of the engraving workers to noise. shown in Table 5.12.

Table 5.12 Averages of noise levels and noise exposure levels for engraving department

Engraving Machines Working Areas		
Factories	Working Area Noise Values (Averages)	Personal Noise Exposure Values (Averages)
Factory 1	75,7	89,9
Factory 2	77,2	-
Factory 3	82,8	-
Factory 4	89	91,1
Factory 5	88,7	90,1

.

When the weaving machines that are being measured in the factories except engraving machine are measured; the ambient noise levels and the personal noise exposure measurements 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 5.5.

Figure 5.5 Carpet back coating, working area, working area measurement point and worker position

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 personal noise exposure 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 5.6.

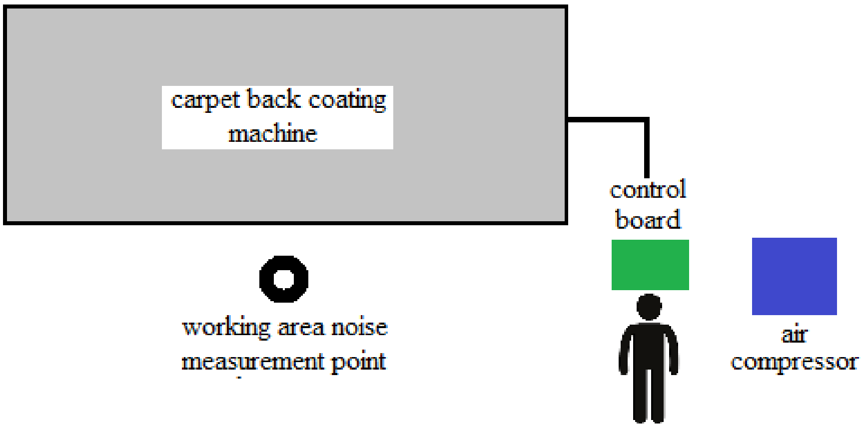

Figure 5.6 Location of the air compressor and control panel causing the Factory 2 personal exposure to be high

In addition, the noise level average of the engraving work areas and the level of exposure of the engraving workers to noise. shown in Table 5.13.

Table 5.13 Averages of noise levels and noise exposure levels for carpet back coating department

Carpet Back Coating Working Areas		
Factories	Working Area Noise Values (Averages)	Personal Noise Exposure Values (Averages)
Factory 1	74,8	-
Factory 2	77,4	83,2
Factory 3	76,3	70,7
Factory 4	79,4	78,2
Factory 5	79,2	77,2

Another important step where the noise level is important according to the measurements is the automation machine. The automation machine work area is a machine that overlays the right and left sides of the carpet and rolls it in rolls. Actually it does not work at a noise level which can be a risk. Figure 5.7 shows the machine and operator.

Figure 5.7 Automation machine working area and automation machine

When the measurements were examined, the Factory 2 and Factory 5 's work area noise levels were found to be lower than the individual noise exposure levels in the workplace due to their location relative to the source of noise during operation, in the automation machine work area and personal noise exposure values. But; In Factory 3 and Factory 4, the work area noise level was found to be higher than workers' personal noise exposure levels. The reason for this is that workers in automation machines change their position during operation relative to the machine's noise source (Figure 5.8).

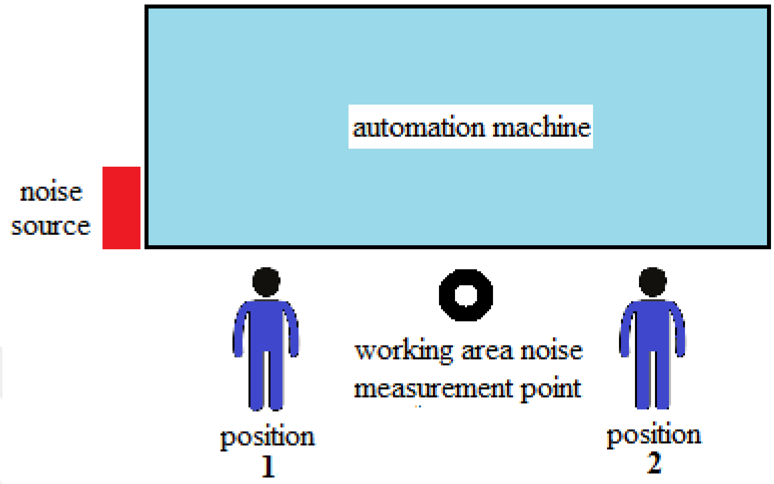

Figure 5.8 Positions where automation workers have increased and decreased personal noise exposure

When measurements are made, the working environment noise measurement microphone is positioned at the exact midpoint as shown in Figure 5.8. The personal exposure to noise is increased when the occupants are in position 1 as in Position 1, as when the noise source is close to the noise measurement microphone, while personal exposure is reduced as in Position 2, as when away from the noise source.

In addition, the noise level average of the engraving work areas and the level of exposure of the engraving workers to noise. shown in Table 5.14.

Table 5.14 Averages of noise levels and noise exposure levels for automation department

Automation Machines Working Areas		
Factories	Working Area Noise Values (Averages)	Personal Noise Exposure Values (Averages)
Factory 1	78,7	-
Factory 2	81,3	85,7
Factory 3	86,7	81
Factory 4	83,5	81,9
Factory 5	80,5	85,7

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 5.9.

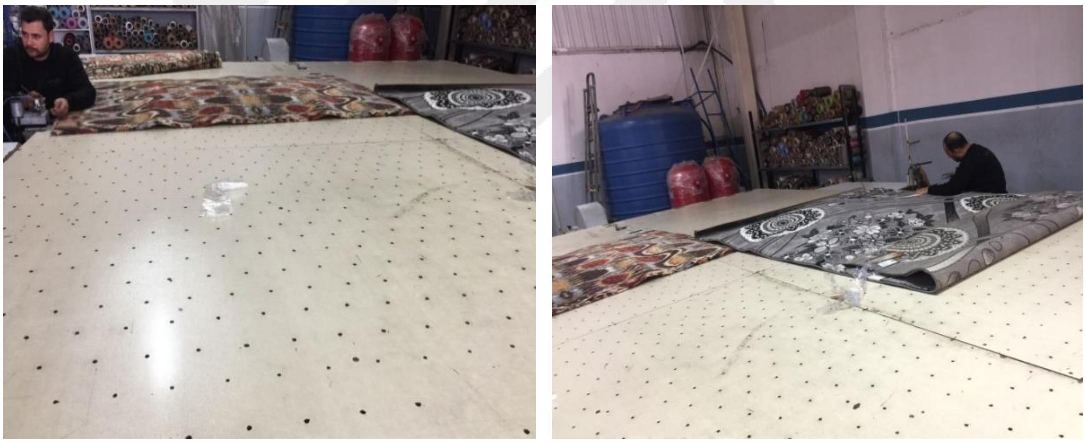

Figure 5.9 Pneumatic table and pneumatic table working area

The noise level of pneumatic table working area is higher than personal noise exposure but it is not a noise risk since it is lower than the highest action value of 85 dB(A).

In addition, the noise level average of the engraving work areas and the level of exposure of the engraving workers to noise. shown in Table 5.15.

Table 5.15 Averages of noise levels and noise exposure levels for pneumatic table department

Pneumatic Table Working Areas		
Factories	Working Area Noise Values (Averages)	Personal Noise Exposure Values (Averages)
Factory 1	71,9	84,1
Factory 2	78,5	81,9
Factory 3	82,4	-
Factory 4	79,2	82,2
Factory 5	-	-

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 (carpet back coating, automation machine and pneumatic table work areas), it can be said that the noise level is not at risk but at a height that can not be overlooked. In these sections, workers have the obligation to keep earplugs.

CHAPTER 6

CONCLUSION

6.1 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 personal noise exposure 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 mostly exposed to the workers who work in the weaving section and carving section of the personal noise exposure. 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 show 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 the 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 the 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 personal noise exposure 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, personal noise exposure of this department is higher than that of 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 personal noise exposure. For example, in Factory 2 and Factory 5 the personal noise exposure measurement is higher than the ambient noise level, while Factory 3 and Factory 4 the personal noise exposure measurement 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 personal noise exposure 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, prefferring 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 personal noise exposure 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 protector Daily and audit the using of it regularly to decrease the personal noise exposure below the regulatory limit.
- Train workers regularly to conduct hearing tests and use personal protective equipment.

As a result, in this thesis, the noise levels in the carpet factories were measured, the exposure that the workers made in this noise was 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.

6.2 Limitations of Study

The noise measurement values of this thesis study were made in five carpet weaving factories. The measurements in the factories were not made for all departments because the machines did not work at the same time, the managers did not allow it and the employees did not accept them. For this reason only the most important departments of the carpet weaving factories have been tried to be measured

6.3 Further of Study

As a continuation of this work, hearing tests of workers in the weaving and engraving department of carpet factories can be done in examinations with the medical faculty to determine the rates of hearing loss compared to the time worked by the workers.

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