# A STUDY ON RISK ASSESSMENT REGARDING SAUSAGE PRODUCTION LINE

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**I hereby 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.**

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## ABSTRACT

### A STUDY ON RISK ASSESSMENT REGARDING SAUSAGE PRODUCTION LINE

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In terms of occupational accidents in the manufacturing sector, the rate of occupational accidents in food manufacturing sector is highest after fabricated metal products manufacturing. Meat processing is the sector with the highest number of occupational accidents among food products. In this study, the risks encountered in meat processing in a sausage production line are evaluated. The reason of selecting the sausage production line is that it contains many of the hazards involved in meat processing . Within the scope of this study, two factories were visited and one of them was chosen to carry out the risk assessment study on the sausage production line. There was already an assessment by the selected facility in which L-type matrix method was applied. In this study, risk assessment is done by Failure Modes and Effects Analysis (FMEA) method and Machine Safety Regulation (MSR) is used as a confirmation tool.

The reason why FMEA method was chosen is that it includes detectability component as well as probability and severity which provide a more detailed assessment. Furthermore, the machines which are instensely used for sausage production were examined in the framework of MSR. A checklist called Machine Safety Regulation Checklist (MSRC) was prepared for this examination.

Six different sections were determined to carry out the risk assessment study and 121 risks were determined at the end of study. Among these 6 sections, machines were found as the most hazardous section which covers 30% of of the risks, which is the highest percentage that any section has. Moreover, 274 risk factors were determined which are considered as root causes of failures of FMEA method. Again, 30% of the risk factors are machine related. In that respect, machines are evaluated deeply in terms of selected parameters by performing MSRC.

Based on the results of the study several preventing actions are recommended, such as moving parts of the machines need to be covered, operation of machines should be prevented while the covers are open and periodic maintenance should be carried out in order to decrease the risk level. One of the drawbacks of machines is the high noise level which can only be reduced by replacing them with new ones. It is highly recommended to supply hearing protectors to the workers until the noise level of machines is reduced below 80dB. Lastly, both production area and work order should be arranged such that non slip floors, adequate ventilation, periodic measurements of environment and personal exposure.

Keywords: Occupational Health and Safety, Occupational Accident, Risk Assessment, Meat Processing, Sausage Production Process

# ÖZ

## SOSİS ÜRETİM HATTINDA RİSK DEĞERLENDİRMESİ ÇALIŞMASI

Biçer, Şeniz
Yüksek Lisans, İş Sağlığı ve Güvenliği
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İmalat sektöründe yaşanan iş kazaları bakımından gıda ürünleri imalatında yaşanan iş kazaları, fabrikasyon metal ürünleri imalatından sonra en çok iş kazası yaşanan sektördür. Etin işlenmesi ise gıda ürünleri arasında en çok iş kazası yaşanan sektördür. Bu çalışmada, bir sosis sosis üretim hattında etin işlenmesinde karşılaşılan riskler değerlendirilmiştir. Sosis üretim hattı, etin işlenmesinde bulunan tehlikelerin pek çoğunu bünyesinde barındırdığından seçilmiştir. Bu çalışma kapsamında 2 adet işletme ziyareti gerçekleştirilmiş ve bunlardan bir tanesi sosis üretim hattında risk değerlendirmesi çalışmasının gerçekleştirilmesi için seçilmiştir. Seçilen işletmenin L tipi matris metodu kullanılarak yapılmış bir risk değerlendirmesi mevcuttur. Bu çalışmada Hata Türü ve Etkileri Analizi (FMEA) yöntemi uygulanmış ve Makina Emniyeti Yönetmeliği doğrulama aracı olarak kullanılmıştır.

Olasılık ve şiddetin yanı sıra saptanabilirlik bileşenini de kullanarak daha detaylı değerlendirme imkanı sağladığı için FMEA yöntemi seçilmiştir. Buna ek olarak sosis üretiminde yoğun olarak kullanılan makineler Makina Emniyeti Yönetmeliği çerçevesinde incelenmiştir. İnceleme için Makina Emniyeti Yönetmeliği Kontrol Listesi (MSRC) olarak adlandırılmış bir control listesi hazırlanmıştır.

Risk değerlendirmesi çalışmasının yürütülmesi için altı bölüm belirlenmiş ve çalışmanın neticesinde 121 adet risk tespit edilmiştir. Bu altı bölüm arasında

toplam risklerin %30'unu ihtiva eden makineler en riskli bölüm olarak bulunmuştur. Buna ek olarak FMEA yöntemi ile bulunan hataların kök sebepleri olarak değerlendirilen 274 risk faktörü bulunmuştur. Bu risk faktörlerinin de %30'u makineler ile ilişkilidir. Bu nedenle makineler, seçilen parametrelere dayanılarak MSRC uygulaması ile derinlemesine değerlendirilmiştir.

Çalışmanın sonuçlarına bağlı olarak makinelerin hareketli aksamların kapatılması, korumalar kapalı değilken makinelerin çalışmasının engellenmesi ve risk düzeyinin düşürülmesi için makinelerin periyodik bakımlarının düzenli yapılması gibi birçok önleyici tedbir tavsiye edilmiştir. Makinelerin sakıncalarından bir tanesi yalnızca yenisisyle değiştirilerek ortadan kaldırılabilecek olan yüksek gürültü seviyesidir. Gürültü seviyesi 80dB'in altına indirilene kadar çalışanlara işitme koruyucu donanımların temin edilmesi ziyadesiyle tavsiye edilmiştir. Son olarak hem üretim alanı hem de çalışma düzeni, kaymaz zeminler, yeterli havalandırma, periyodik ortam ölçümleri ve kişisel maruziyet ölçümleri gibi önlemler ile düzenlenmelidir.

Anahtar Kelimeler: İş Sağlığı ve Güvenliği, İş Kazası, Risk Değerlendirmesi, Et Üretimi, Sosis Üretim Süreci

To my husband

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To my father Haşmet Öğe, I know that you will be proud of me if you were here also I promise you that I will always try to honor you every day of my life. I also want to thank to my mother Beyza Esen who always love me unconditionally. From family there is one last thanks to my brother Görkem , who always has fun of my education and studies.

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| | |
|---|---|
| AMI | American Meat Institute |
| FMEA | Failure Modes and Effects Analysis |
| ILO | International Labor Organization |
| İBYS | Occupational Health and Safety Information Management System |
| MSR | Machine Safety Regulation |
| MSRC | Machine Safety Regulation Checklist |
| OHS | Occupational Health and Safety |
| OSHA | Occupational Safety and Health Authority |
| PPE | Personal Protective Equipment |
| RPN | Risk Priority Number |

# CHAPTER 1

# INTRODUCTION

## 1.1 Background Information

The first recorded instance of risk analysis is practiced by Asipu. They were a group of people who had lived in Tigris-Euphrates valley about 3200 B.C. They served as consultants for decisions on risky, troublesome and unclear situations. If an important decision such as marriage, war, buildings, etc. was required, it was asked for an Asipu member. These people did research for all the aspects of the problem. For this purpose, Asipu members collected information and produced a chart to evaluate all the alternatives. Then, minus and plus signs were used for loss, profit, success, failure, etc. In this first known risk analysis, there is no confidence interval or probability of failure and the ancient Asipu people asserted that their results are accurate (Mumpower, 1985).

If the roots of modern quantitative risk analysis are desired to find, it is necessary to study the religious ideas about afterlife. This search began with Plato's Phaedo in the 4$^{th}$ century B.C. There was a lot of analysis discussing the afterlife in terms of pagans and Christians. One of them is carried out by Arnobius who lived in 4th century A.D. In this study Arnobius asserted a number of arguments on Christianity and one of them is considered as the base of probabilistic risk analysis. Arnobius prepared a 2x2 matrix in which there are "accept Christianity" or "remain a pagan" and "God exists" or "God does not exist". According to the results of the matrix, Arnobious decides which is good for one's soul (Mumpower, 1985).

Centuries later, many improvements take place in the late 17$^{th}$ and 18$^{th}$ centuries. For instance, Arbuthnot claimed that "the probabilities of different potential causes of an event could be calculated". Later, in 1792, a prototype of modern qualitative

risk assessment is developed by LaPlace about the probability of death whether smallpox vaccination is used or not (Mumpower, 1985).

Occupational health and safety (OHS) has gained its scientific and social meaning by going through different stages. Since the existence of humanity, people have had to work to meet their various needs. First of all, they struggled against nature with hand tools they made using materials such as stone and wood, and so they tried to meet their basic needs. Over time, these tools were insufficient, instead of small tools, they developed more useful mechanical tools (Paşa, 2007).

These work tools have been replaced by machines over time and the production process has become more complex. Working environment, production tools and working people have been in continuous interaction throughout the entire historical process of humanity. As a result, various health and safety problems have been raised. Throughout history, developments in working life have also been a source of developments in occupational health and safety (Paşa, 2007).

Risk assessment is applied for many different disciplines until now (Solms, 2009). Occupational health and safety risk assessment is also changed related with technologic developments (ILO, 2019).

## 1.2 Statement of the Problem

Many national and international institutions publish guidelines to cover OHS in overall food industry. Although some of these institutions have studies on OHS specific to meat industry, the detailed studies on different branches of meat industry are scarce.

The risk assessments of most meat manufacturing facilities are almost the same printed forms. They are not studied and completed specific to OHS conditions of the subject facility. This study is aimed to show that a specific risk assessment study is more effective in order to understand the present OHS condition of facility and to suggest measures which are specific to the facility.

## 1.3 Objectives and Scope of the Study

The main objective of this study is to present a new approach of risk assessment studies by specifying the topic. The studies based on sectors mostly are far from the requirements of field today. If the studies are more specific on a topic, the outcomes are going to be more effective.

In the light of this information, this thesis is performed by the assessment of the risks of sausage manufacturing line. This study is performed as a field study which provides information directly from facility where sausage is produced.

The scope of this thesis is to identify hazards and evaluate the risks by FMEA method. In addition, a checklist called Machine Safety Regulation Checklist (MSRC) is prepared for detailed evaluation of production machines. The aim of MSRC is to confirm the FMEA results and evaluate manufacturing machines in detail.

## 1.4 Research Methodology

Two meat production facilities are visited during this study. One of them is a medium scale with 290 employees and chosen to observe good manufacturing practices and also to check the risk assessment data. In this facility, live animal goes in and all kind of meat products from raw meat to further processed products (sausage, sucuk, etc.) goes out. The second facility is a small scale one with 131 employees which is chosen to perform the risk assessment.

Among all other meat processing operations, sausage production line is chosen because it includes both manual and mechanical work and most of the risks of meat production are observable on sausage production line. Hazards are identified and risk assessment is performed in this facility. Also, control measures are identified and shared with the facility.

It is observed that both of the meat production facilities use L-type risk assessment method which does not have a specific assessment for the machines. However, it is observed that machines pose great danger in addition to the nature of the meat work. There are both mechanical risks as well as human factors in which a qualitative method is better applicable (TSE, 2019). That is why Machine Safety Regulation (MSR) is taken into consideration in this study.

MSR is examined comprehensively and MSRC is produced and then it is confirmed by both occupational health and safety experts on Ministry of Family, Labor and Social Services and occupational experts on facilities of the field study.

Moreover, Failure Modes and Effect Analysis (FMEA) method is used for risk assessment on the chosen line. The probability, severity and detectability values are decided with a team whose members are occupational safety expert, food engineer and employee representatives. The field data is then confirmed by occupational health and safety experts on Ministry of Family, Labor and Social Services.

During FMEA application, risk factors are evaluated in addition to the method itself. The purpose of examining risk factors is to identify the root causes of the risks.

## 1.5 Outline of the Thesis

This study includes five chapters. The first one is the Introduction where general information about this thesis is given. The next chapter is about literature survey. General and statistical information about the sector and information about sausage production is given within the scope of this chapter. Following chapter explains the method of this study in detail. Risk factors, FMEA scores and MSRC data is evaluated and discussed in the next chapter called as Results and Discussion. The final chapter is comprised with the conclusions of this study and recommendations are given in this chapter. FMEA and MSRC tables are given in Appendices.

# CHAPTER 2

# LITERATURE REVIEW

Occupational accidents results in deaths, disabilities, injuries and financial loss (Ceylan, 2012). Risk management plays a significant role on the prevention of occupatonal accidents. Occupational health and safety management system statistics indicate that food products manufacturing is in the second rank of the number of occupational accidents since 2016 to 2019 first quarter in Turkey. Meat manufacturing and storage as well as manufacturing of meat products are in the dangerous class (AÇSHB, 2012). Red meat production is in the third rank of occupational accidents in food products manufacturing line of work (İBYS, 2020a). Therefore, manufacturing activities in this sector should be monitored and detected and risk assessment should be made in order to decrease occupational accidents and diseases (ILO, 2019).

Based on the dramatic increase of population around the world, the necessity of red meat and poultry increases (Ritchie, 2019). Number of meat manufacturing facilities increases consistently both in Turkey and the world. Red meat production increases continuously since 2000 according to the data of both United States Department of Agriculture (USDA) and Food and Agriculture Organization (FAO) of United Nations and Turkey Statistics Institution (TÜİK).

## 2.1 Meat Production Sector in the World and Statistics

The basis of meat production is stockbreeding. Stockbreeding generates 40% of total gross product of the World and it is the livelihood of 1.3 billion people. 3,929 billion bovine and ovine animals are produced and 1,363 billion of them is slaughtered in order to produce 85 million tons of red meat (USDA, 2019). Table

2.1 shows the meat production in 2017 (FAOSTAT, 2017). It is clear that chicken has the highest share followed by cattle as the source of meat production.

Table 2.1 The number of slaughtered animal and meat production in the world in 2017 (FAOSTAT, 2017)

| Animal | Number of Animals (head) | Slaughtered (head) | Meat Production (tons) | Meat Production Ratio (%) |
|---|---|---|---|---|
| Cattle | 1,491,687,240 | 304,414,858 | 66,250,349 | 33.7 |
| Sheep | 1,202,430,935 | 567,720,570 | 9,498,356 | 4.8 |
| Goat | 1,034,406,504 | 464,598,299 | 5,853,336 | 3 |
| Chicken | 22,847,062,000 | 66,566,725,000 | 109,056,179 | 55.5 |
| Turkey | 459,369,000 | 663,605,000 | 5,948,197 | 3 |
| Total | 27,034,955,679 | 68,567,063,727 | 196,606,417 | 100 |

The first 20 red meat producer countries in the World and their production in 2017 are listed in Table 2.2 (FAOSTAT, 2017).

Table 2.2 Amount of meat production in 2017 (FAOSTAT, 2017)

| | Country | Amount of Total Red Meat Production (tons) |
|---|---|---|
| 1 | United States of America | 33,837,696 |
| 2 | China | 25,031,501 |
| 3 | Brazil | 23,862,601 |
| 4 | Russia | 6,279,799 |
| 5 | Mexico | 5,256,300 |
| 6 | India | 5,142,658 |
| 7 | Argentina | 5,054,908 |
| 8 | Australia | 4,002,746 |
| 9 | Turkey | 3,577,079 |
| 10 | France | 3,046,678 |
| 11 | United Kingdom | 2,980,000 |
| 12 | South Africa | 2,844,591 |
| 13 | Pakistan | 2.729,000 |
| 14 | Germany | 2,643,741 |
| 15 | Spain | 2,285,062 |
| 16 | Italy | 2,090,157 |
| 17 | New Zealand | 1,316,669 |
| 18 | Uzbekistan | 1,045,175 |
| 19 | Nigeria | 972,230 |
| 20 | Sudan | 761,544 |

## 2.2 Meat Production Sector in Turkey and Statistics

Meat consumption in Turkey increased 95% in the last 20 years (OECD, 2018). The number of slaughtered animals and meat production increases almost every year. The number of slaughtered animals increases 13% between the years 2000-2017; also the amount of meat shows 56% increase (TÜİK, 2017). Technological improvements in stockbreeding resulted in higher increase in meat production compared to increase in number of animals (TÜİK, 2016).

## 2.3 Production Process

There are a lot of products within the context of further processing of raw meat. Sucuk, sausage and salami are the main products. Moreover, pastırma, dried meat, roasted meat and kofte are the other further processing products. Figure 2.1 is the flowchart showing the sausage production steps.

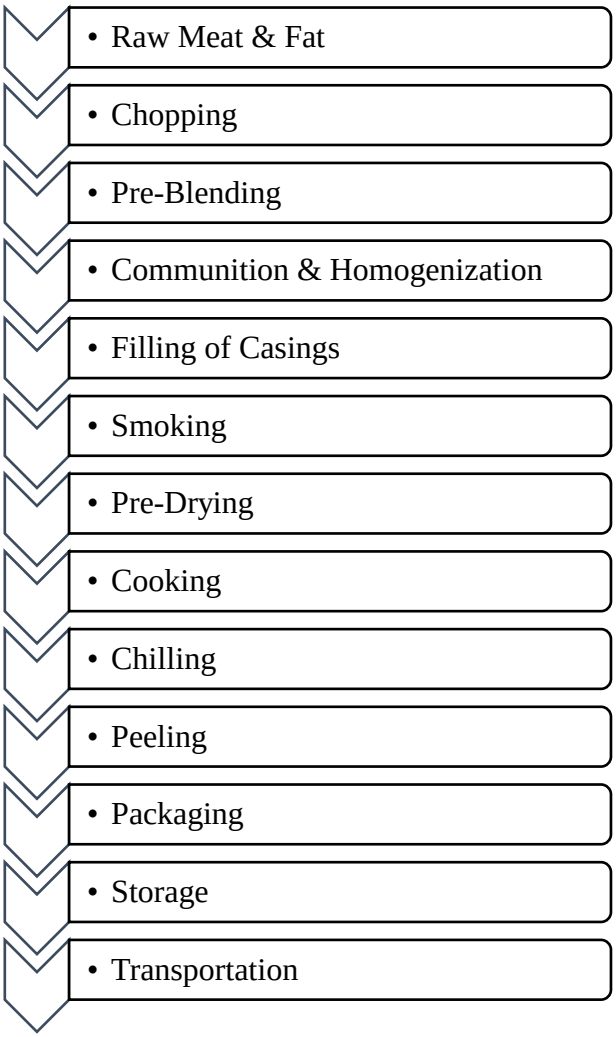


Figure 2.1. The process flowchart of sausage production

Sausage production line is a further processing of meat production and includes both manual and mechanical work. Machines used for sausage production are listed in the following paragraphs:

- **Cuter**: It both mixes and slices meat and raw material. Cuter performs the chopping and pre-blending steps of sausage dough formation (Figure 2.2)..

Figure 2.2. Cuter

- **Bandsaw**: It has a fixed platform where frozen or other meat blocks are sliced (Figure 2.3).

Figure 2.3. Bandsaw

- **Grinder**: It is used to get minced meat from whole meat (Figure 2.4).

Figure 2.4. Grinder

- **Homogenizator**: It is the last machine to form the sausage dough into emulsion. It performs communition and homogenization (Figure 2.5).

Figure 2.5. Homogenizator

- **Sausage Filler**: It is used to fill the dough which is the output of cuter into sausage, sucuk and salami casings (Figure 2.6).

Figure 2.6. Sausage filler

- **Sausage Peeler Machine**: It tears off the casings of cooked and cooled sausages (Figure 2.7).

Figure 2.7. Sausage peeler machine

- **Cooking Rooms**: Smoking, pre-drying and cooking steps are performed in cooking rooms, respectively. Smoking is important for the color and flavor of sausages. It takes 25 minutes at 65°C. Pre-drying is aimed to decrease the surface humidity. A light crust formation is achieved. This step is performed at

60$^{o}$C for 15 minutes. Then, the sausages are cooked for 20 minutes at 85°C (Figure 2.8).

Figure 2.8. Cooking rooms

- **Labeling and Packaging Machines**: There are 2 packaging machines. The first one is thermoform which makes box shape modsified atmosphere packages. The second one is called thermovac. This is used for vacuum packages (Figure 2.9).

Figure 2.9. Labeling and packaging machine

## 2.4 Occupational Accidents in Meat Sector of Turkey

The number of occupational accidents in red meat and poultry sectors is 3398 and 9577, respectively since 2016 (İBYS, 2020b). Poultry or red meat is used for sausage production in Turkey. That is why the statistics of these two sectors are examined in this study. The combined occupational health and safety statistics for meat and poultry production is shown in Table 2.3 (İBYS, 2020b).

Table 2.3 Number of occupational accidents in meat production sector of Turkey (İBYS, 2020b)

| Years | *Number of employees who had occupational accident* | *Number of lost work days* | | |
|---|---|---|---|---|
| | | *Work on accident day* | *Accidents with 1-4 days of disability* | *Accidents with more than 5 days disability* |
| 2016 | 2,483 | 1,189 | 810 | 397 |
| 2017 | 3,476 | 1,956 | 1,088 | 432 |
| 2018 | 3,143 | 1,991 | 803 | 349 |
| 2019 | 3,831 | 2,460 | 910 | 461 |
| Total | 12,933 | 7,596 | 3,611 | 1,639 |

Table 2.3 indicates that there exist steady increase in the number of occupational accidents. The number of employees faced with occupational accidents rise 54% from the year 2016 to 2019 (İBYS, 2020b). The increase in production capacity of the sector is thought to be the main reason of this increase. There exists expansion of the capacity of existing facilities as well as new facilities are built.

## 2.5 Risk Assessment Studies on Similar Food Manufacturing Facilities

To fulfil OHS requirements is relatively hard in food industry than other sectors because of food safety. Food safety requirements cover microbiological hazards, chemical contaminants, biological toxins, residues, etc (FAO, 2003). Sometimes,

there is a conflict between occupational safety requirements and food safety issues. For instance, sharp corners may be covered with a soft material like pad; however, this is not applicable in a food manufacturing plant because the soft pad is not safe in terms of food hygiene. Although there is no direct study related sauage production line similar studies food industry are discussed in the following paragraphs.

Examination of similar studies is significant in order to perform new studies. Moreover, developing present study also depends on the examination of past studies (Bilgiç, 2019). In the light of this information a literature survey is performed and several studies are chosen to investigate. There is no study on the same topic with current study; thus, similar projects are selected for investigation.

A study performed in a frozen food facility applied L-type matrix method to assess the risks of the facility (Yanık, 2018). Facility is divided into several sectors (production, storage, electric wiring and stevedore) then the risk scores and suggestions of measurements for each sector were given. In total, 127 risks are determined of which 50 of them are high risk and 67 of them are medium risk. Only 10 risks have low scores in which precaution is not necessary to be taken. It is concluded that the risk scores and results are not compared with the risk assessment of the plant as whole (Yanık, 2018).

Şahan (2015) carried out a risk assessment study in sugar refineries. At first, occupational accidents in sugar refineries were investigated and it was shown that detailed studies on OHS was needed in sugar refineries. Within the context of this study a pilot facility was examined in detail. The plant was divided into 14 sections and Fine Kinney method was applied for each section, separately. According to the results of the application, suggestions are given to prevent occupational accidents (Şahan, 2015).

Another study with L-type matrix method was performed in a food manufacturing plant. Facility was divided into sections and 64 risks were determined. Evaluated risks and possible measurements were given in that study (Çolak, 2014).

A study on OHS in a bakery indicated that FMEA application in food manufacturing was an effective to improve safety of employees. It was asserted that FMEA method was usable to minimize the occurrence of occupational accidents. Production process was divided into stages and potential hazards were identified and risk priority numbers were calculated. As a result, 4 of the potential hazards were found with risk priority numbers higher than 100 which means high risk to employees. The results of the study showed that slip, head hit by an elevator, fire and leakage are the most potential hazards with RPNs of 140, 108, 100 and 100, respectively (Ramadhan, 2019).

Although the last example is not from food industry it is mentioned here because of the application of FMEA Analysis . The study is performed in an aerospace plant. At first, the present condition in the plant was observed. It was found that the technical safety is implemented by rules and instructions but there was no specific method applied for indvidual workplaces to follow specific measurements. Then, risk priority numbers (RPN) were calculated for present condition in the chosen workplaces and precautions were identified. A second FMEA application is performed by an assumption that all precautions have been implemented. The results of second FMEA study indicated that RPN was decreased 57% compared to fisrt FMEA (Söylemez, 2006).

# CHAPTER 3

# METHODOLOGY

As mentioned earlier L-type matrix method is already applied by the facility as the risk assessment tool. In this study, it is aimed to apply Failure Modes and Effects Analysis (FMEA) method to caary out risk analysis on sausage production line of the meat production facility. In addition, Machine Safety Regulation (MSR) will be used as a second tool for risk analysis since many processes require mechanical operations involving heavy machines.

This chaper is devoted to give detailed information on both methdos.

## 3.1 FMEA Method

FMEA method is firstly developed and used by US army on the purpose of detecting system and equipment failures and determining the effects of these failures. Later it is used by NASA for confidence needs of space travels in late 1960s. This method is kept in secret for a long time. It is used in American aircraft industry in between 1970-1975, Ford motor facility in 1972 and computer manufacturing in 1975. It is standardized by three big American automotive companies in 1988 (Kahraman *et al.*, 2010; Liu *et al.*, 2011).

There are four types of FMEA methods which enables preventive measures (Wang *et al.*,2009):

- System FMEA
- Design FMEA
- Process FMEA
- Service FMEA

FMEA method evaluates all the possible ways of occurrence of a failure (problem, malfunction, risk and anxiety). A decent FMEA study provides the analysts the ability to define known and potential failure modes, determination of their reasons and effects, adjustment of priority order for determined failure modes and also performing corrective actions for these failures (Wang *et al.*, 2009).

FMEA method is sometimes called as failure modes and effects criticality analysis (FMECA). FMECA improves FMEA by the way of rating the significance and criticality of every failure mode. Criticality analysis is usually qualitative or semi-quantitative; however, it can be made quantitative by using actual failure ratios. Many failures will be detected during FMEA application. It has great importance to organize them with regard to possibility of occurrence and seriousness of effects (Özkılıç, 2014; TSE, 2019).

Figure 3.1 gives a detailed flowchart of the FMEA method. As seen from the flowchart that three main factors are used to determine failure priorities with FMEA method. These are **possibility**, **severity of effect** and **detectability**. Calculation is performed by Equation 3.1(Wang *et al.*, 2009).

$$RPN = P \times S \times D \qquad \text{Eq. 3.1}$$

where:

RRN = Risk priority number

P = Probability

S = Severity

D = Detectability

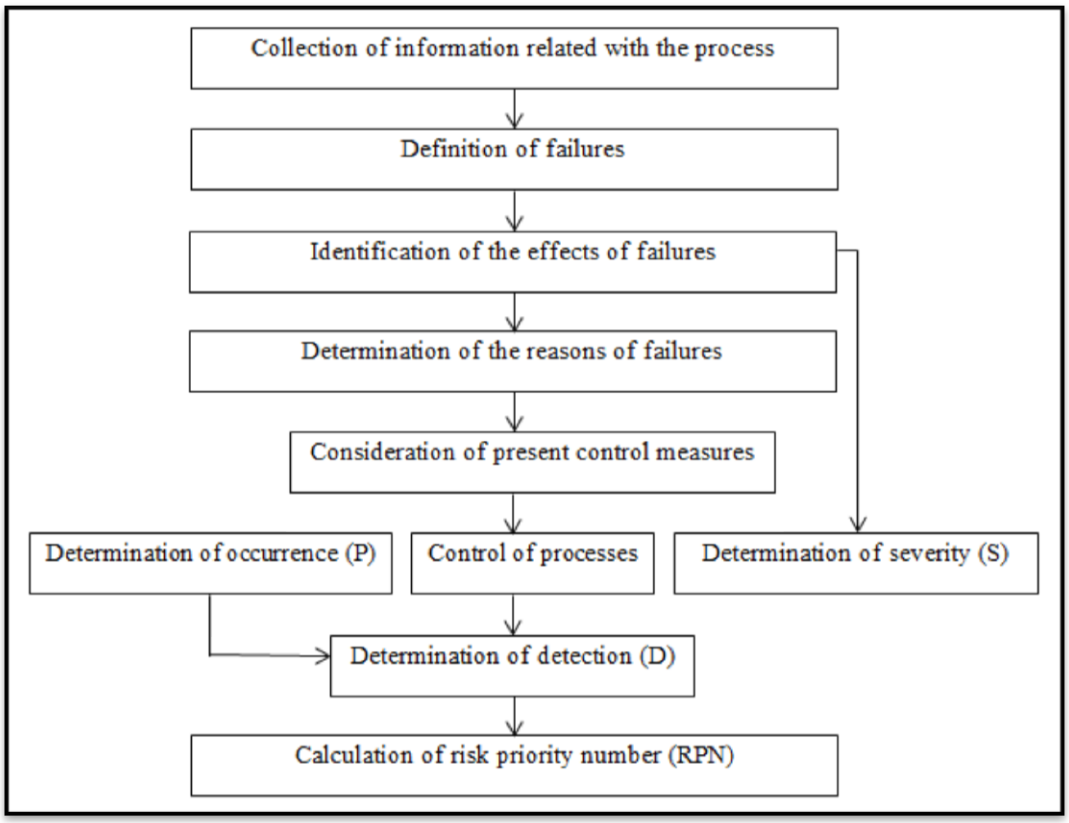


Figure 3.1. Flowchart of FMEA method

FMEA results are recorded on risk table. After the calculation of risk priority number for every possible failure, the criticality order of these numbers is decided. The first precaution must be for the failure which has the highest priority order number because the higher the priority order number is, the more significant the hazard is (Özkılıç, 2014). Priority, severity and detectability ratings are listed in Tables 3.1, 3.2 and 3.3, respectively (Kahmaram *et al*., 2010; Wang *et al*., 2009).

Table 3.1 Priority rating table of FMEA method (Kahraman *et al.*, 2010; Wang *et al.*, 2009)

| Degree | Possibility | Possible Failure Ratio |
|---|---|---|
| 10 | **Very high** failure is almost inevitable | ≥ 1/2 |
| 9 | | 1/3 |
| 8 | **High** repetitive failure | 1/8 |
| 7 | | 1/20 |
| 6 | **Medium** failures occurring sometimes | 1/80 |
| 5 | | 1/400 |
| 4 | | 1/2000 |
| 3 | **Low** more rare failures | 1/15 000 |
| 2 | | 1/150 000 |
| 1 | **Far** failure is not likely | 1/1 500 000 |

Table 3.2 Severity rating table of FMEA method (Kahraman *et al.*, 2010; Wang *et al.*, 2009)

| Degree | Effect | Severity of effect |
|---|---|---|
| 10 | Danger without warning | Failure resulting disastrous effect without warning |
| 9 | Danger with warning | Failure resulting disastrous effect with warning |
| 8 | Very high | Destructive failure resulting complete damage of system, multiple deaths and severe injuries |
| 7 | High | Failure resulting system breakdown due to equipment loss, death and serious injury |
| 6 | Medium | Failure resulting system breakdown due to insignificant damages and very serious injury (loss of limb, permanent disability) |
| 5 | Low | Failure resulting system breakdown without any damages and injuries resulting work day loss |
| 4 | Very Low | Failure decimating system performance and resulting slight injuries like small cuts, bruises, stratches, , etc. |
| 3 | Insignificant | Failure that results in a small decrease of system performance |
| 2 | Very insignificant | Failure that system is in operation with very little intervention |
| 1 | No | Failure with no effect |

Table 3.3 Detectability rating table of FMEA method (Kahraman *et al.*, 2010; Wang *et al.*, 2009)

| Degree | Detectability | Criteria |
|---|---|---|
| 10 | Completely impossible | The reason of potential failure and the detectability of its following failure is impossible |
| 9 | Very far | The reason of potential failure and the detectability of its following failure is a very far possibility |
| 8 | Far | The reason of potential failure and the detectability of its following failure is a far possibility |
| 7 | Very low | The reason of potential failure and the detectability of its following failure is very low |
| 6 | Low | The reason of potential failure and the detectability of its following failure is low |
| 5 | Medium | The reason of potential failure and the detectability of its following failure is at average level |
| 4 | Relatively high | The reason of potential failure and the detectability of its following failure has relatively higher possibility |
| 3 | High | The reason of potential failure and the detectability of its following failure is high |
| 2 | Very high | The reason of potential failure and the detectability of its following failure is very high |
| 1 | Almost certain | The reason of potential failure and the detectability of its following failure is in all likelihood |

One of the advantages of FMEA method is that instead of taking precautions for each risk one by one, most effective solutions for whole system are found primarily. It means that the solutions which improve the whole system better are found properly and primarily (Wang *et al.*, 2009).

The result of FMEA method is risk priority number. It means that the output of this method is risks. Rating of risk priority number (RPN) is given in Table 3.4. If RPN is higher than it has the highest risk and it is a must to take a precaution.

Table 3.4 Risk priority number rating table of FMEA method (Kahraman *et al.*, 2010; Wang *et al.*, 2009)

| Risk Priority Number (RPN) | Precaution Condition |
|---|---|
| RPN>100 | Precaution must to be taken. |
| 40<RPN<100 | Precaution can be taken. |
| RPN<40 | Precaution is not necessary to be taken. |

### 3.1.1 Risk Factors

FMEA is a proactive method for evaluating the process whether it might fail (IHI, 2017). However, the root causes of these risks are as significant as the risks. That is why the risk factors are identified. They are examined together with failure during application of FMEA method. Table 3.5 shows the risk factors.

Table 3.5a Table of risk factors

| Risk Factor Code | Category | Sub-Risk Factor Code | Sub-Risk Factor |
|---|---|---|---|
| **F-1** | Physical | 1 | Noise |
| | | 2 | Vibration |
| | | 3 | Moving parts |
| | | 4 | Forklift, transpalet |
| | | 5 | Equipment used (knife etc.) |
| | | 6 | Pressure |
| | | 7 | Object fall |
| **F-2** | Chemical | 1 | Allergens |
| | | 2 | Abrasive materials |
| | | 3 | Harmful to the environment |
| | | 4 | Toxic substances |
| | | 5 | Irritants |
| | | 6 | Acids |
| | | 7 | Cancerogens |
| | | 8 | Solvents |
| **F-3** | Biological | 1 | Bacteria |
| | | 2 | Viruses |
| | | 3 | Fungi |
| | | 4 | Allergens |
| | | 5 | Irritants |
| | | 6 | Prions |
| **F-4** | Thermal | 1 | High-temperature materials |
| | | 2 | Low-temperature materials |
| **F-5** | Electricity | 1 | High voltage |
| | | 2 | Damaged electricity line |
| | | 3 | Static load |
| | | 4 | Short circuit |
| **F-6** | Fire and Explosion | 1 | Combustible materials |
| | | 2 | Inflammable materials |
| | | 3 | Physical explosion |
| | | 4 | Chemical explosion |
| | | 5 | Electricity |
| | | 2 | Waste |
| | | 3 | Lack of periodic control |
| | | 4 | Lack of emergency measures |
| | | 5 | Other hazards |

Table 3.5b Table of risk factors

| Risk Factor Code | Category | Sub-Risk Factor Code | Sub-Risk Factor |
|---|---|---|---|
| **F-7** | Working Environment | 1 | Narrow spaces |
| | | 2 | Confined spaces |
| | | 3 | Working at height |
| | | 4 | Unsuitable floors |
| | | 5 | Unsuitable workbenches |
| | | 6 | Untidy environment |
| | | 7 | Very hot environment |
| | | 8 | Very cold environment |
| | | 9 | Working at night |
| | | 10 | Insufficient lightening |
| **F-8** | Ergonomic | 1 | Improper posture positions |
| | | 2 | Carrying and lifting heavy loads |
| | | 3 | Repetitive work |
| | Personal | 4 | Working without obeying the rules |
| | | 5 | Overconfidence |
| | | 6 | Not using PPE |
| | | 7 | Getting sick and / or tired |
| | | 8 | Lack of supervision |
| | | 9 | Repression and stress |
| | | 10 | Absence and forgetfulness |
| F-9 | General | 1 | Structure and building borne |
| | | 2 | Waste |
| | | 3 | Lack of periodic control |
| | | 4 | Lack of emergency measures |
| | | 5 | Other hazards |

## 3.2 Machine Safety Regulation

The aim of MSR is to arrange evaluation criteria for the safety of machines. It is expected that machines do not produce any harm to human health and safety if duly installation, periodic maintenance and usage only on purpose is provided. Any risk assessment by MSR is performed in the context of selected parameters of the main parameters listed below (STB, 2009):

- Ergonomics
- Control Systems
- Mechanical Hazards
- Noise
- Vibration

- Maintenance and repair
- Machine Instruction Manuals
- Food Machines
- Moving Machines
- Fire
- Explosion

Based on these parameters a Machine Safety Regulation Checklist (MSRC) is prepared (Table 3.6).

All titles in the regulation are not assessed because some of them are not applicable in the field. Although this study is only focused on sausage production machines, the regulation covers all the machines in all sectors. Furthermore, only machine usage is taken into consideration within this study although the regulation is oriented to machine producers. Meanwhile, this is also the reason why this regulation is chosen as risk assessment tool. It is based on design; thus, it provides perspective for proactive approach to occupational health and safety for the machines of sausage production line.

Table 3.6a Machine Safety Regulation Checklist (MSRC)

| **Machine Safety Regulation Checklist** | | | **Prepared by** | Şeniz Biçer | |
|---|---|---|---|---|---|
| | | | **Date** | | |
| | | | **Machine Name** | | |
| **Main Parameter** | **Control Topic** | **Control List** | **Applicable** | | **Not Applicable** |
| | | | **Yes** | **No** | **NA** |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | | |
| | Working Positions | Operator can avoid long-term monitoring | | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | | | |
| | | Predictable human failures do not cause hazardous situations | | | |
| | | Machine does not start unexpectedly. | | | |
| | | If the protective devices are not fully active, machine stops automatically. | | | |
| | Control Units | When stop command is given, machine stops immediately. | | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | | | |
| | | When machine is stopped the energy of activator mechanism is cut. | | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | | | |
| | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | | |
| | | Machine cannot be started unless the protections are locked. | | | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | | | |
| | | Machine is isolated in order to lower noise value. | | | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | | | |

Table 3.6b Machine Safety Regulation Checklist (MSRC)

| **Machine Safety Regulation Checklist** | | **Prepared by** | Şeniz Biçer | | |
|---|---|---|---|---|---|
| | | **Date** | | | |
| | | **Machine Name** | | | |
| **Main Parameter** | **Control Topic** | **Control List** | **Applicable** | | **Not Applicable** |
| | | | **Yes** | **No** | **NA** |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | | | |
| | | Energy source connection is locked while maintenance and repair continues. | | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | | | |
| | Content | Information on setting and maintenance work is present. | | | |
| | | Description of the aim and details of use is present. | | | |
| | | Operation method in case of an accident or failure is present. | | | |
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | | | |
| | | Surfaces are smooth. | | | |
| | | There is not any protrusion or holes where organic compounds can place. | | | |
| | | Any substance on the machine including the grease never contact with food. | | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | | | |

Table 3.6c Machine Safety Regulation Checklist (MSRC)

| **Machine Safety Regulation Checklist** | | **Prepared by** | Şeniz Biçer | | |
|---|---|---|---|---|---|
| | | **Date** | | | |
| | | **Machine Name** | | | |
| **Main Parameter** | **Control Topic** | **Control List** | **Applicable** | | **Not Applicable** |
| | | | **Yes** | **No** | **NA** |
| Moving Machines | Position of Driver | Driver has clear vision. | | | |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | |
| | Control Systems | Remote controller is specified to one machine. | | | |
| | | All control units are easily and immediately reachable by driver. | | | |
| | | There is sound warning signal for backward movement. | | | |
| | | There is visual warning signal for backward movement. | | | |
| | Operation | The machine does not move unintentionally. | | | |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | |
| | | In case of emergency, battery connection is possible to cut. | | | |
| | Fallen Objects | Machine is covered with a protective roof. | | | |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | | | |

# CHAPTER 4

# RESULTS & DISCUSSIONS

The purpose of this study is to identify the hazards, to evaluate the risks and to make recommendations for the elimination or minimization of risks in a meat processing plant in Ankara. In this context, the risks of sausage production line are assessed with FMEA method and then production machines are analysed in detail by using MSRC.

L type matrix risk assessment method is the most widespread method in meat manufacturing facilities and it is the case for the facility studied in this thesis. The easy implementation of L type matrix method is the main reason that facilities prefer to use it. On the other hand, the probability rating of the risk values and the precautions cannot be identified in detail by L type matrix method because the evaluation intervals are narrow (Özkılıç 2015). If the value range is wider, 2 different risks whose values are different from each other are possible to be calculated as the same value.

As the result of drawbacks of L type matrix method, if the facility has a full-time occupational safety expert, he/she will know the processes well; thus he/she can examine the reasons of the failures then apply a better method say, FMEA method. L type matrix method has probability and severity values as variables to calculate the risk value but FMEA method has detectability as one more variable in addition to probability and severity. Thus, the range of risk value is wider when FMEA method is applied. It is much easier to rank the risk results by priority order.

The main steps of this study are as follows:

1. The first step of the study is to read the risk assessment study already finalized by facility. It is a study by L type matrix method in which 111 risks are detected. 41 of them are unacceptable risks and 70 of them are

remarkable risks. No acceptable risk is identified. However, it is observed that 11 of the unacceptable risks and 8 of the remarkable risks are evaluated twice. In this case, it is revealed that 92 risks have been identified. The distribution of 92 risks is like this: 30 unacceptable risks and 62 remarkable risks. Commonly encountered risks in red meat production facilities are knife cut, slip, trip, fall, working at height and they are included in this risk assessment, too. However, biological risks are not mentioned. For the measures determined in relation to the risks, a deadline is not specified and the priority order is not ranked.

2. As the first step of current risk assessment, sausage production process is analyzed and related hazards are identified. Since the main aim of the study is to carry out a risk assessment of the whole sausage production process, the records of occupational expert and physician are examined and this data is used to calculate probability value for the FMEA method by receiving opinion of employees and unit chiefs.
3. In the light of the information gained from thefirst step, the sub-processes are determined.
4. Types of failures and the effects of failures are identified for each sub-process.
5. Then, the reasons of failures are examined.
6. In addition, present control measures of the facility are also taken into consideration and additional control measures are planned with contribution of occupational safety expert of the facility.
7. As the ultimate result of the study, the risk factors are designated in order to have countable results and also categorize the risks. Although the risk priority number of FMEA method demonstrates the risk level, the number of risk factors provide additional detailed information about the risks.

Analysis of the sausage production process is realized under seven sections as listed below:

- Raw Material Preparation Room: This room is dedicated for preparation of ingredients other than meat.
- Production: This is the general area allocated for sausage production.
- Machines: This section includes all the machines in the sausage production line.
- Storage Rooms: It covers all the cold storage areas.
- Lifting Devices: Forklifts and transpalets are examined here.
- Transportation Vehicles: This section includes the trucks to deliver the end product.
- Overall: The parameters evaluated in this section are indirectly related with sausage production line. However, any failure in these parameter inevitably affects production. For instance, fire extinguishers, fire exit, generators, etc. are evaluated in this section.

The risk priority numbers for these 7 sections are calculated and the results are shown on Figure 4.1. Machines are the most risky sections because the risk priority number is the highest. The risk priority numbers of machines and lifting vehicles are higher than 100 so they are on the red zone. Thus, precaution must be taken immediately for these sections.

Production, overall, storage rooms and vehicles are on the yellow zone for which precaution can be taken. It is explained that after actions are taken in the sections of red zone, precautions should be taken in these 4 yellow zones for occupational safety.

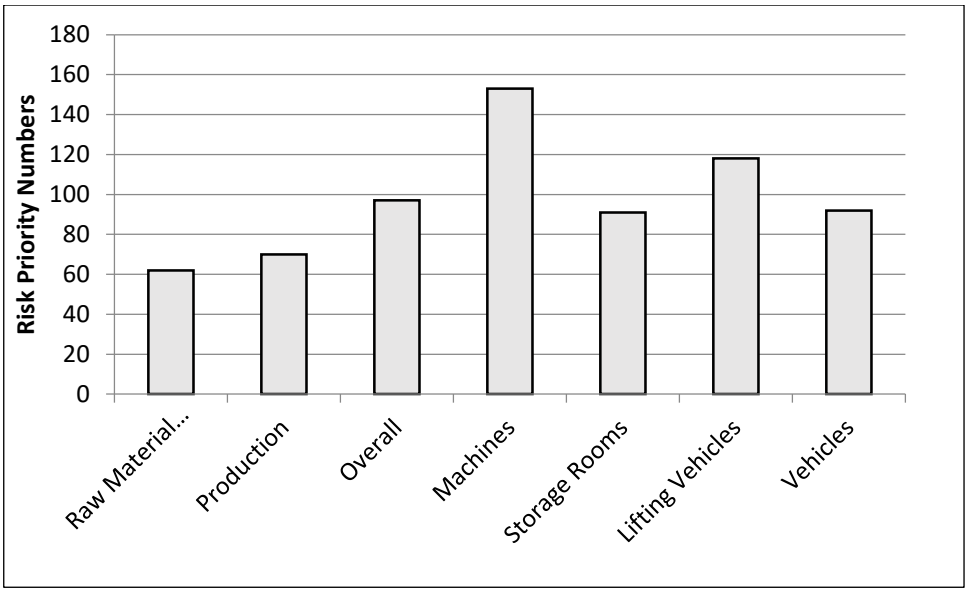

Figure 4.1. Numerical distribution of risk priority number in facility

In this study machines of sausage production line evaluated one by one with both FMEA method and MSRC. In facility's risk assessment, machine protections are examined as one risk generally, but some of the machines are investigated separately by occupational safety expert of facility. These are explained in the following sections.

## 4.1 Distribution of Risks on Raw Material Preparation Room

The ingredients of sausage except meat are prepared in raw material preparation room by food engineers. The risk priority number is calculated as 62 in yellow zone. Figure 4.2 shows that chemical, working environment and ergonomic risk factors are present. There are 3 main failures in raw material preparation room. The first one is directly related with raw materials itself. The ingredients such as pepper, salt, coloring agents, food additives etc. cause dusty environment and also the possibility of allergy. As a result of dusts, floor of the room is slippery. The dust covers the lightening equipment and the dust results in reduction in vision of employee. Finally, stools are used in that room. The explanation is that the room is

small and there is no place for office work chairs. Although stools are not covering larger areas, they are not ergonomic and they have potential of back and waist pain.

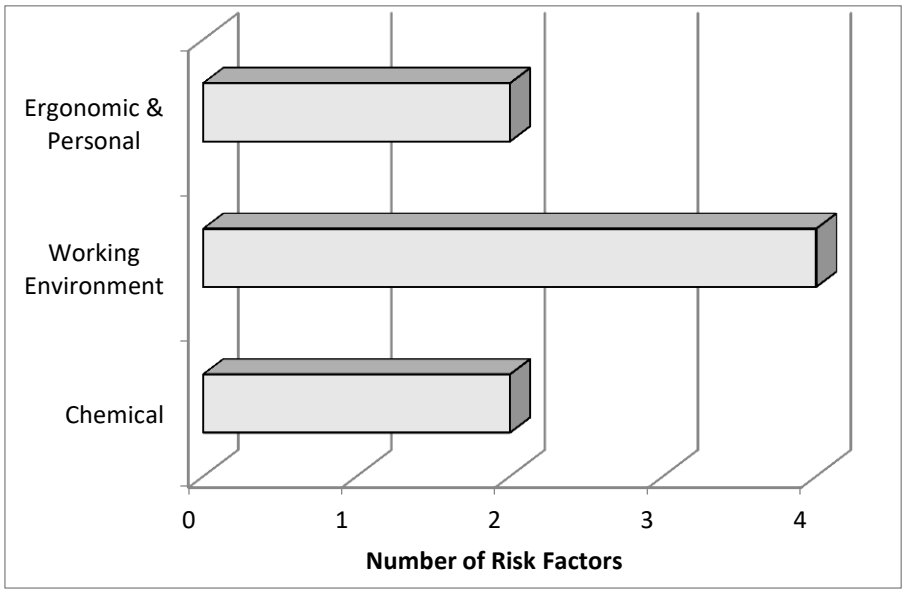


Figure 4.2. Distribution of risk factors in raw material preparation room by FMEA method

## 4.2 Distribution of Risks on Production Machines

### 4.2.1 Distribution of Risks on Machines in terms of Risk Priority Number by FMEA Method

As it can be seen from Figure 4.3 that there are 12 machines on sausage production line. Only 3 of them are in yellow zone although all the rest of the machines are in red zone. The graphic demonstration of this distribution is shown on Figure 4.4.

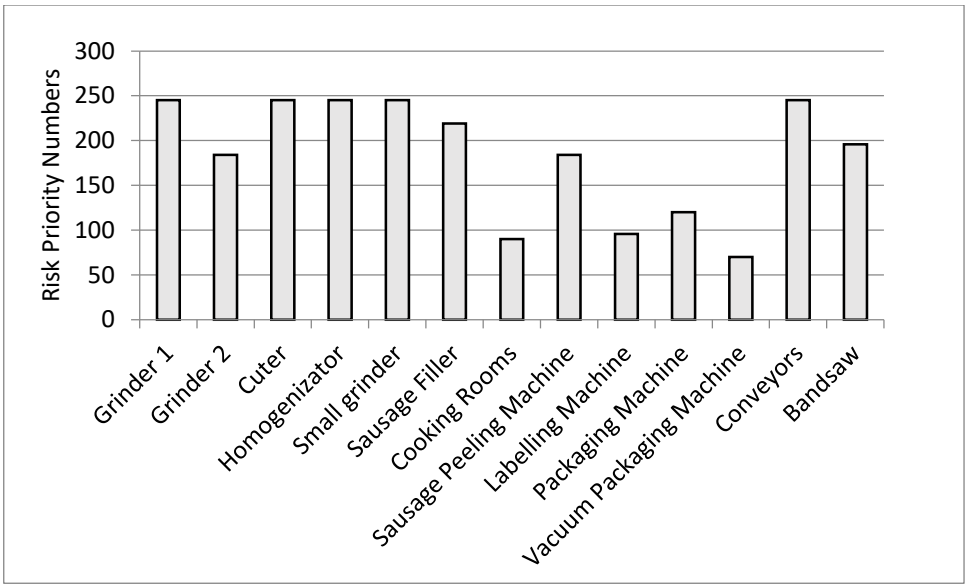


Figure 4.3. Numerical distribution of risk priority number in machines of production

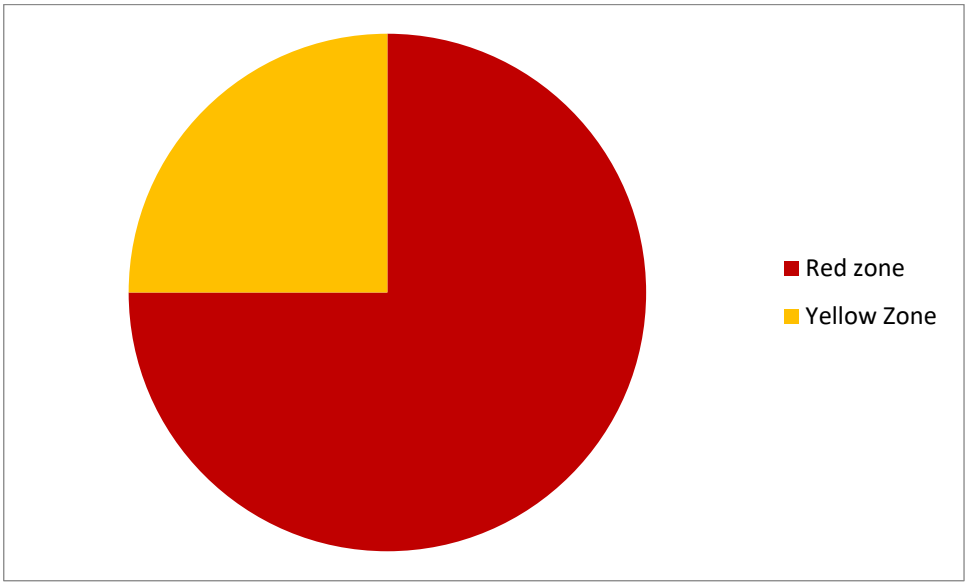


Figure 4.4. Distribution of risk factors in machine related risk factors by FMEA method

### 4.2.2 Distribution of Risks on Machines in terms of Risk Factors by FMEA Method

Risks are firstly evaluated for all machines in the facility. The analysis is performed depending on risk factors. 77 risk factors are found. The distribution of these risk factors are shown on Figure 4.5.

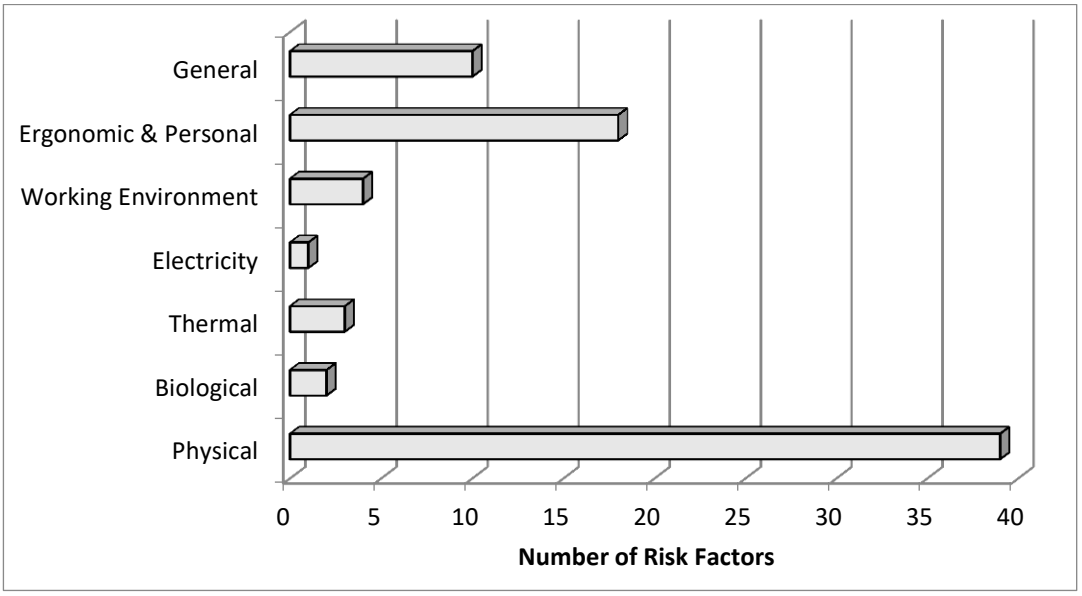


Figure 4.5. Distribution of risk factors in machine section by FMEA method

It is detected that 39 of this 77 risk factors are physical risk factors. 28 of them are related with unprotected machines. Either the machine protections are not present or they are not locked. That is why machines can be operated without the protections are placed and locked.

Thus, employees may touch the moving or sharp parts of the machines. When the machine cover is not closed and the protectors are not in place it must be prevented from operating. Otherwise, the probability of injuries or even loss of limbs increases seriously. Physical risk factors which belong to the machines such as machine protectors, moving and rotating parts of machines are collected under the heading of “machines”.

Furthermore, 9 of the physical risk factors are resulted from noise because machines are not isolated. The distribution of physical risk factors are shown on the Figure 4.6.

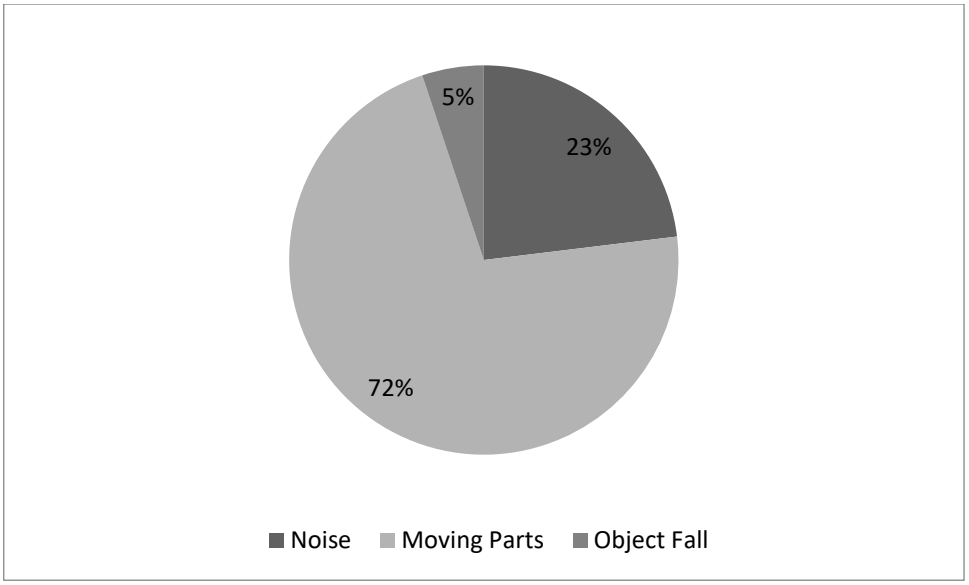


Figure 4.6. Distribution of physical risk factors in machine section by FMEA method

In this study all machines on sausage line are examined in terms of noise. It is detected that the noise level of sausage peeler is 92 dB and the noise level of grinder 2 is 90 dB. These are the machines with highest level of noise. Moreover, the noise level of vacuum packaging machine is 81 dB. Thus, it is necessary to consider noise as a significant risk factor. The machines are not in separate rooms, they are on production area. Not only the operators but also all employees on production area is affected from the noise. (AÇSHB, 2013).

There are 17 human induced and ergonomic risk factors. 10 of them are due to not using PPE. Management cannot provide adequate isolation for these three machines and they provide PPE. However, most of the employees do not use the ear protectors. 2 of them are ergonomic risk factors; that are based on the non-ergonomic machines of thermoform and thermovac. Thermoform is used for shaping the bottom packages. The weight of the molds exceeds 30 kg. Although the

machine has a plug-in to remove molds, it is not used on the grounds that it is too bulky. Thermovac is the machine that puts the modified atmosphere in the package to increase the shelf life of the product by taking the air in the package. Then, it closes the package. The weight of the rolls of this machine is 25-30 kg. Both the molds and the rolls are lifted and placed on the machine by manual handling. The rest are overconfidence and working without obeying the rules because employees do not read the user manual of machines and disabling the label-lock system of machines. In addition, there is repression and stress.

The rest of the risk factors are related with, thermal, human induced and ergonomic and working environment.

### 4.2.3 Occupational Health and Safety Requirements of Machines in terms of MSRC

In this study, risk assessment on machines is performed by using MSR which is related with EU Directive 2006/42/EC. There are also ISO standards related with this directive which are possible to guide of ensuring machine safety. According to ISO 12100 Standard, there are 3 steps of risk reduction to be applied after risk assessment. These steps are (TSE, 2010):

- By design
- By technical precautions
- By user warning measures

These 3 steps are applied in this study, too. Firstly, the risk assessment is performed and then the precautions are determined. Firstly, it is advised that the old machines should be changed with the new technology machines in order to decrease the risk level. However, the employer of the facility is not willing to renew the machines. Therefore, technical precautions are proposed such as

machine protections and additional isolation, etc. Finally, warning measures to employees are identified and shared.

There is also EN 14119 Standard which is about safety of machinery interlocking devices associated with guards and EN ISO 13849 Standard which is about safety requirements and guidance about control systems of machinery (TSE, 2014; TSE, 2016). Within the context of the thesis, these 2 standars are studied. There are 2 types of protections of machines which are constant and moving protections. For example, the conveyors can be protected by constant barriers in order to prevent finger jam as suggested on the risk assessment in this study. On the other hand, cuter or sausage filler is protected by removable cover. The problem here is that, these machines have removable cover, but they are operable while the covers are on. This situation is analyzed on Chapter 5 in detail. In sum, machines which are in this condition like cuter does not fulfill the requirements of these standards completely.

Each machine was evaluated individually according to all the topics in the checklist. Moreover, the results for each machine is explained in detail on the following topics of machines. There are some subjects on the MSRC that any machine has. One of them is that machines are not adjustable to the height of employees. Thus, for tall or short employees, musculoskeletal disorders are almost inevitable. Also, machines do not include any sitting equipment for the operator.

In addition, all machines used in sausage production line is grounded. Thus, after the energy is cut, the energy normally left or stored in the circuits of the machines wipes out without causing any risk to employees. Moreover, all machines have instruction manuals prepared in Turkish. Although the operators do not use them on the field, this is not a requirement for MSRC. Also, each operator is trained on site and training continues until he/she learns the machine completely. In additon, all machines has start-stop buttons separately and an individual emergency stop button.

### 4.2.4 Distribution of Risks on Cuter

The cuter on the facility is operable without closing its cover. Table 4.1 demonstrates that the failure of cuter is contact with moving parts. There are spinning sharp blades with 1500 rpm speed in that machine. The operator begins with low rotation speed and adds some of the ingredients while rotating and then manually intervenes the machine by mixing with an apparatus. Then, the operator closes the machine cover and increases the speed of rotation. However, the blades are very dangerous. The risk priority number of cuter is 245 which is in red zone due to this appplication. Otherwise, cuter might be operated safely in terms of OHS with 78 dB of noise unless it does not have a lock and label system.

Table 4.1 Risk assessment of cuter by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-3 | Cuter | Contact with moving parts | Injury<br>Loss of limb | Operating cuter with open cover | 7 | 7 | 5 | 245 |

In addition to the risk assessment performed by FMEA method, MSRC is applied. According to MSRC, there are some safety requirements to be fulfilled. Predictable human failures may cause hazardous situations because cuter can be operated with open cover. Moreover, there is electricity risk because of isolation from energy source parameter. The employees responsible for maintenance and repairs usually unplug the cuter. Then, maintenance and repair is performed. After that, they need to try the machine so, they plug in. If there is still any problem, they go on without unplugging. Hence, this parameter is evaluated as a risky situation in MSRC.

The detachable parts are expected be removed easily by MSR; however, the high speed rotation of cuter needs additional precautions. The blades are not easily removable. Although this is a problem for cleaning process, it is necessary for safety of chopping. Thus, this parameter does not fulfill the requirements of MSRC, but it makes the machine safer in terms of occupational safety.

### 4.2.5 Distribution of Risks on Bandsaw

The usage of bandsaw possesses high risk factors because of an open and moving blade. Table 4.2 shows the risk assessment of bandsaw. The employee may touch the blade and it would cause serious injury. Also particles may splash because the blade is open. Eye protectors and steel cord fabric gloves can produce safety to a point. However, the eye protector steams up and the gloves decreases the movements and if it is caught by the moving saw, it is almost impossible to rescue the hand from the saw while it is still moving. Hence, it is better to not to use them.

Table 4.2 Risk assessment of bandsaw by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-3 | Bandsaw | Object splash | Injury | Bone splash | 7 | 6 | 4 | 168 |
| F1-7 | | | Loss of eye | | | | | |
| F1-3 | | No machine protectors | Injury | Contact with moving blade | 7 | 7 | 5 | 245 |
| F8-6 | | | Loss of limb | | | | | |
| F4-2 | | Long time contact with cold material | Occupational disease | Cutting frozen meat | 7 | 5 | 5 | 175 |

Bandsaw is also assessed in terms of MSRC. It is the only machine whose height is adjustable to the employee. However, any failure in control may cause hazardous situations due to moving open blade. Also, the precautions taken to prevent risks from falling or splashing parts are not enough. Although the operator has protective googles, other employees working in that field do not have these. Thus, they may be affected by splashing parts. Moreover, the operator cannot use protective gloves because of their additional risk factors of grabbing the hand by the machine. In this case, he may not be able to save his hand from moving parts because of the protective gloves. Bandsaw is not used on routine. Although this is not enough for safety, it is the factor decreasing the frequency of the failure of this machine.

### 4.2.6 Distribution of Risks on Meat Grinders

Sometimes, the exit of minced meat is blocked. The employees try to open the exit while the grinder is operating. It is quite possible that their hand may be caught. Also, the second grinder has 90 dB noise level and it is impossible to be protected by using PPE. It is necessary to solve this problem with a solution on the source.

There are three grinders which are used for production. Grinder 1 is in the further processing area where sausage is manufactured. Grinder 2 and small grinder is used for minced meat production in meat chopping area. Small grinder is used for only backup. If the capacity of grinder 1 and 2 is not enough, small grinder is operated. All of these three grinders which are used for sausage production are evaluated by using FMEA method and the results are shown on Table 4.3. The risk priority number for grinder 2 is lower than grinder 1 because if employee intervenes the machine while it is operating, the machine automatically stops by itself. The only risk factor of this closed machine is noise which is at a very high level. The detectability value for the noise risk factor is low because hearing loss is easily measured. Periodical health controls are very efficient in this issue.

Table 4.3 Risk assessment of grinder by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-3 | Grinder 1 | Contact with the moving parts | Injury<br>Loss of limb | Manual intervention while feeding the machine | 7 | 7 | 5 | 245 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | Grinder 2 | Noise level is 90 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | 8 | 4 | 2 | 64 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Temporary hearing loss | | 7 | 4 | 3 | 84 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Permanent hearing loss | | 6 | 6 | 3 | 108 |
| F1-3 | Small grinder | Contact with the moving parts | Injury<br>Loss of limb | Manual intervention while feeding the machine | 7 | 7 | 5 | 245 |

Grinder 1 has risk related with moving parts in terms of MSRC, too. The operator intervenes both the input and output of the machine with bare hand while it is still on. Grinder 1 operates with the noise level of lowest exposure limits, it does not possess the risk of loss of hearing. There is one more issue detected. According to the requirements of MSRC, machine must be designed to allow minimum product spread to inner parts. Grinders are closed machines in which raw meat goes in and minced meat goes out. Meat residues sticks to inner working parts of the machine. That is why, cleaning of grinders are harder than other machines of sausage production. All of the findings above is true for small grinder, too.

Grinder 2 is safer than grinder 1 in terms of risks related with moving parts. Although the moving parts are closed in all grinders, the input and output holes have bigger diameters that hand can easily go in. Grinder 2 has sensors. When hand comes close to the feeding and/or output holes, the sensors stop the machine immediately. However, grinder 2 is not operating with the noise level of lowest exposure limits. The noise level of it which is higher than the limits and there is no additional isolation in order to lower noise value. If the noise level of machine is not low from design, it is very hard to provide isolation later. This situation is prevalent for all food production machines because of food safety requirements. Also, it is right for old machines, too. When machine gets older and/or maintanance and repair is not performed periodically, the noise level increases. The The cost of machines are high; hence, it is very hard for the facility to renew old technology machines. Thus, periodic maintenance and repair is vital.

Three grinders are examined separately in this study. However, the occupational safety expert of facility evaluated these 3 grinders as one and their risk score is in yellow zone. In this study the risk score of each grinders is in red zone because grinders are very hazardous machines with high speed moving cutters, the risk of loss of limb is a serious issue to be considered. The necessary precaution is using a plastic meat pusher instead of hand to push the meat into the machine. In this study this is the second precaution. The first one is that the mouth width of the grinders should be such that the hand cannot enter and the distance to the cutters should be out of the reach of the fingers.

### 4.2.7 Distribution of Risks on Homogenizator

Homogenizator is used for combining the ingredients and the meat. If the employee intervenes the machine while operating, finger jam is likely possible as it can be seen from the high risk priority number calculated by FMEA method on Table 4.4.

Table 4.4 Risk assessment of homogenizator by FMEA method

| Risk Factor No | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-3 | Homogenizator | Contact of employee with the moving parts | Injury<br>Loss of limb | Manual intervention while working | 7 | 7 | 5 | 245 |

According to MSRC, predictable human failures may cause hazardous situations because there are moving parts of the machine which are possible to be touch while working. The machine has a glass window to view the product but it becomes dirty while working. When the vision is not clear the operator can open the door of the machine in order to check the formation of dough. Meanwhile, the machine is still working.

According to the risk assessment of facility , the risk score of homogenizator is in yellow zone and there is precaution to not intervene the machine while operating. In this study, the homogenizator is in red zone because of the moving parts. It is suggested that machine operation should be prevented before the safety cover is completely closed.

### 4.2.8 Distribution of Risks on Sausage Filler

Sausage filler is blocked very often because the casings are stuck in the machine easily. The operator must interfere with this situation. However, the speed of the production line is high. The pressure of achieving daily production limit affects the operator. The machine is always cleaned without stopping. That is why the risk priority number is very high.

Feeding of machine is done by using trolleys. According to FMEA method, the possibility fall while tipping of the trolleys is low; however, severity is high and detectability is far. The values are on Table 4.5. Thus, the risk score is high. The trolley fall may cause serious harm to employees and also, it results in very slippery floor which may cause additional accidents.

Table 4.5 Risk assessment of sausage filler by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-3 | Sausage Filler Machine | Contact with moving parts | Injury Loss of limb | Manual intervention while feeding | 7 | 7 | 5 | 245 |
| F1-3 F1-7 F8-3 | | Tipping of feeding trolley | Injury Loss of limb | Improper installation of the feed trolley | 3 | 7 | 8 | 168 |
| F1-3 | | Contact with moving parts | Injury Loss of limb | Unsafe cleaning while machine is operating | 7 | 7 | 5 | 245 |

According to MSRC, operator cannot avoid long term monitoring because the casings stuck in the machine. The stuffed sausages are not collected by automatic hanger system in the facility where this study is performed. Thus, the operator hangs them manually and also watches the machine carefully. If the casing is finished, machine does not stop operator must interfere with the machine. In short, continuous monitoring is vital for sausage peeler machine. If the protective devices

are not fully active, sausage peeler machine does not stop automatically. For instance, the operator changes the casing roll while machine is operating. In order to perform this task, the cover is opened while the machine is still working.

The second facility visited has an accident and the employee was injured badly because of feeding trolley fall. In this study, sausage fillers are examined in terms of moving parts in facilities risk assessment and the risk score is in yellow zone. On the other hand, sausage filler is examined by dividing 3 parts in this study. Firstly, in order to prevent the contact with moving part machine should not work unless the cover of moving parts is open. Secondly, cleaning should be made after the machine is stopped because the operator interferes with the machine during operation due to product jam. The third part is that the feeding trolleys and their junction point should be controlled periodically. The risk score is found in red zone because of these significant risks.

### 4.2.9 Distribution of Risks on Sausage Peeler Machine

The entrance of sausage peeler is narrow which means intervention with hand is impossible and also it has sensors which automatically stops the machine. That is why no failure is expected. The only significant risk related with this machine is noise. As it can be seen from Table 4.6 the noise level is far higher than the upper limit which is 85 dB.

According to MSRC, operator cannot avoid long term monitoring like the sausage peeler machine. There is no risk related with moving parts on that machine because machine stops automatically if the protective devices are not fully active. The sausages goes in to the machine and peeled sausages are automatically goes out of the machine into a trolley. Though, the machine is not operating with the noise level of lowest exposure limits. The noise level is 92 dB and there is no isolation in order to lower the noise value.

Table 4.6 Risk assessment of sausage peeler machine by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-1 F1-3 F8-6 F9-3 | Sausage peeler machine | Noise level 92 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | 8 | 4 | 2 | 64 |
| F1-1 F1-3 F8-6 F9-3 | | | Temporary hearing loss | | 7 | 4 | 3 | 84 |
| F1-1 F1-3 F8-6 F9-3 | | | Permanent hearing loss | | 6 | 6 | 3 | 108 |

### 4.2.10 Distribution of Risks on Cooking Rooms

Sausages are precooked before packaging. This cooking process includes 3 steps. The first one is pre-drying which is performed at 60℃ and then smoking step begins. This is important for both taste and color of sausages. The third and the last step is cooking which is performed with pressurized hot water. That is the main reason of high concentration of steam. The moisture content on cooking area is high and it is possible to cause biological risk factors. The probability is low and detectability is far possible. However, the farther the detectability, the higher the degree of detectability. As a result, the average risk priority number for cooking rooms are 92 which is in yellow zone. The risk priority number is lower than the machine with moving parts. The information is on Table 4.7.

Table 4.7 Risk assessment of cooking rooms by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F3-1<br>F3-3<br>F7-7 | Cooking rooms | Moisture and humidity formation | Biological risks | Inadequate ventilation | 2 | 5 | 8 | 80 |
| F7-1<br>F7-2<br>F8-3 | | Stuck in narrow and confined spaces | Biological risks<br>Exposure to cleaning chemicals<br>Psicological risks | Inadequate ventilation | 6 | 4 | 4 | 96 |
| F4-1<br>F7-1<br>F7-2<br>F7-7<br>F8-3<br>F8-5 | | Early entrance of employee to the room and contact with the walls | Burns | No lock system to prevent opening the doors | 4 | 5 | 5 | 100 |

A failure in software and hardware in control systems may cause hazardous situations because there is both high temperature and steam treatment on the machine. Also, human failures may be hazardous. Although there is no parameter related with narrow and confined spaces, it can be evaluated under the human failures topic by MSRC. Doors are locked while machine is still operating; however, it is possible to open the doors right after the cooking is over. This situation may cause burns and exposure to high level of humidity. Due to this reason cooking rooms are found safe according to MSRC but they are found out in red zone by FMEA method. Furthermore, all cleaning chemicals are easily being cleaned out without any residues by MSRC. On the other hand, the employee who

is responsible for cleaning may be exposed to the vapor of cleaning chemicals due to narrow and confined area.

Inadequate ventilation is examined in both risk assessments and both risk scores are in yellow zone. In this study, it is detected that ventilation system is not enough in the area of cooking rooms and in raw material preparation room. That is why an additional ventilation system is suggested.

### 4.2.11 Distribution of Risks on Labeling and Packaging Machines

The noise level of vacuum packaging machine is 81 dB. Employees in that area do not wear hearing protectors. This failure is in yellow zone because it is obvious to see the failure. The easier the detection of failure, the lower the number of detectability value in FMEA. Detectability is high so, the degree of detectability is low.

Thermoform machine is used for modified atmosphere packaging. The machine produces different shape of packages by using the molds. There is a mechanism to place them but it is asserted that the mechanism is old and bulky. Thus, the employees carry, lift and place the mold manually. The environment is cold in packaging area. The temperature is 4-5$^{\circ}$C. Moreover, the molds are heavy. These two reasons may easily cause back and waist pain. The reason of potential failure and the detectability of its following failure are low because back and waist pain can be resulted from anything. It is hard to associate this with occupational disease.

Extruder ejects modified air inside the package and packages exits on conveyor. There is not any protection the conveyor. Many times manual intervention is needed because the packages slip and hit each other, fall, etc. Emergency stop button is hardly reachable in every point of the conveyor. Due to these reasons, both the possibility and severity of finger jam is high. Detectability is on average. As a result of the multiplication of these values, the failure is in red zone.

Table 4.8 Risk assessment of labeling and packaging machines by FMEA method

| Risk Factor Number | PROCESS / SECTION | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|
| F1-1 F1-3 F8-6 F9-3 | Vacuum packaging machine | Noise level 81 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | 7 | 4 | 2 | 56 |
| F1-1 F1-3 F8-6 F9-3 | | | Temporary hearing loss | | 6 | 4 | 3 | 72 |
| F1-1 F1-3 F8-6 F9-3 | | | Permanent hearing loss | | 5 | 6 | 3 | 90 |
| F1-3 F8-9 | Molds of thermoform | Carrying and lifting heavy loads | Back, waist pain | The molds of thermoform machine are heavier than 30 kg | 5 | 4 | 6 | 120 |
| F1-3 F8-9 | Rolls of thermovac | Carrying and lifting heavy loads | Back, waist pain | The rolls of thermovac machine are heavier than 25-30 kg | 5 | 4 | 6 | 120 |
| F1-3 | Labeling machine | Contact with moving parts | Injury | No machine protectors | 6 | 4 | 4 | 96 |
| F1-3 | Conveyors at the exit of packaging machine | Finger jam | Injury | No protector on the conveyor at the exit of extruder | 7 | 7 | 5 | 245 |

Labeling machine is another subject of facility's risk assessment and the score is in red zone similar to this study. Employees should not contact with the moving parts. Controversial to this study any structural precaution is not suggested like a lock system of moving parts. The risk assessment of labeling and packaging machines are on Table 4.8.

The operator cannot avoid long term monitoring on all the packaging line because all the machines need to be carefully monitored. The operator must follow whether slipping of labels, packages not closing properly, etc. There is also risk related with moving parts according to MSRC. The rolls, top film placing and labelling are open. The bottom film is converted into a box shape by the machine and employees fill the bow manually on the conveyor, and then the top film is covered on the box. During covering, the extruder fills the package with modified atmosphere. Finally, the label is attached. All the moving parts including conveyors are open and possible to contact. Finally, detachable parts of thermoform and thermovac are not easily be removed and attached. The rolls of thermovac and the molds of thermoform are heavy and manually placed. Thus, this operation includes risk factors and it is evaluated with both FMEA and MSRC.

According to a fact sheet published as an ergonomic guideline for meat packaging employees, it is seen that levels of injuries and ilnesses are reduced after the publication of this guideline. Also, programs are tailored to individual facilities (AMI, 2019). Controversially, the results of this study is related with one plant and it can be easily adapted to similar processing plants. Furthermore, American Meat Institute (AMI) proposes that OHS is not a competitive issue and so, they encourage the facilities to share information on OHS practices.

## 4.3 Distribution of Risks on Production Area

In this part risks are evaluated on the area of production. The analysis is performed depending on risk factors. 61 risk factors are found. The distribution of these risk factors are shown on Figure 4.7.

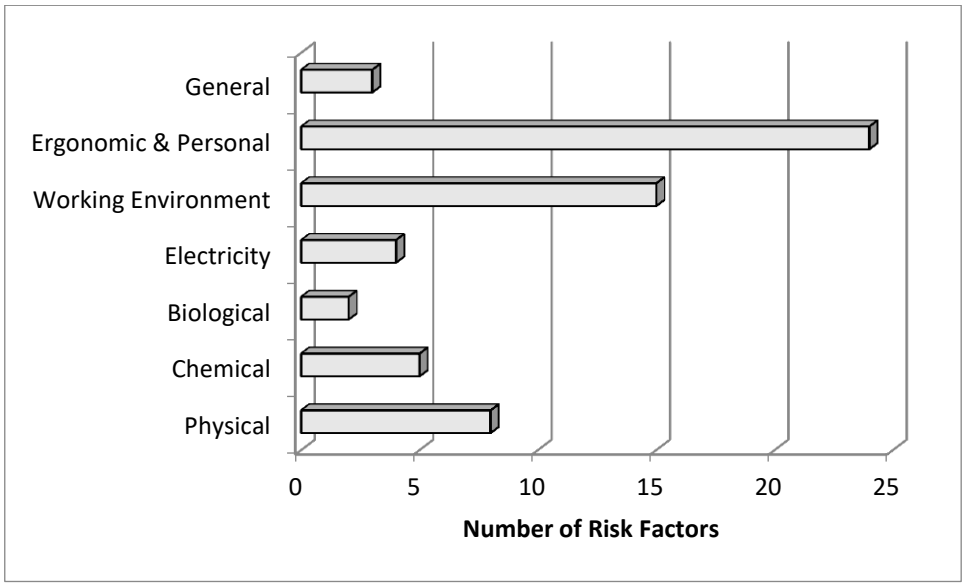


Figure 4.7. Distribution of risk factors in the area of production by FMEA method

The average risk priority number is calculated by FMEA method as 70 which is in yellow zone. However, workbenches are in red zone. Unsuitable workbences may result in back and waist pain. The heights of the workbenches are fixed although they must be adjustable as for the height of employees. Furthermore, another effects of this failure are slips, trips and falls. Due to the wetness and fats the floor is slippery even if the floor material is unslippery. Anti-slip mats are not present in front of the workbenches because of food safety. However, the employee may fall or hit to a moving part. The possibility is high. However, the failure is easily detectable, so the detectability value is low. Yet, the failure is in red zone. The priority number is calculated as 105.

Although the frequency of knife use is lower than the slaughterhouse section, it is not ignorable in further processing. The use of knife in cold environment with repetitive movements is a failure that is in red zone. The risk priority number is calculated as 105, too.

Finally, carrying heavy loads is examined in this section. The average risk priority number of this failure is 116. Employees lift and carry product baskets whose average weight is between 20-40 kg in low temperature area. This may cause serious back and waist pain. Also the floor is slippery so the load may fall and it is possible to harm both the carrying and other employees around. The probability of failure is high here. The failure is expectable so the detectability is high and degree is low because detectability and its degree is inversely proportional.

If the distribution of working environment related risk factors is examined, 4 of them are unsuitable floors, 3 of them are unsuitable workbenches. In addition, insufficient lightening and untidy environment are counted as 2 for each. The rest of the risk factors are very hot environment, very cold environment and confined spaces.

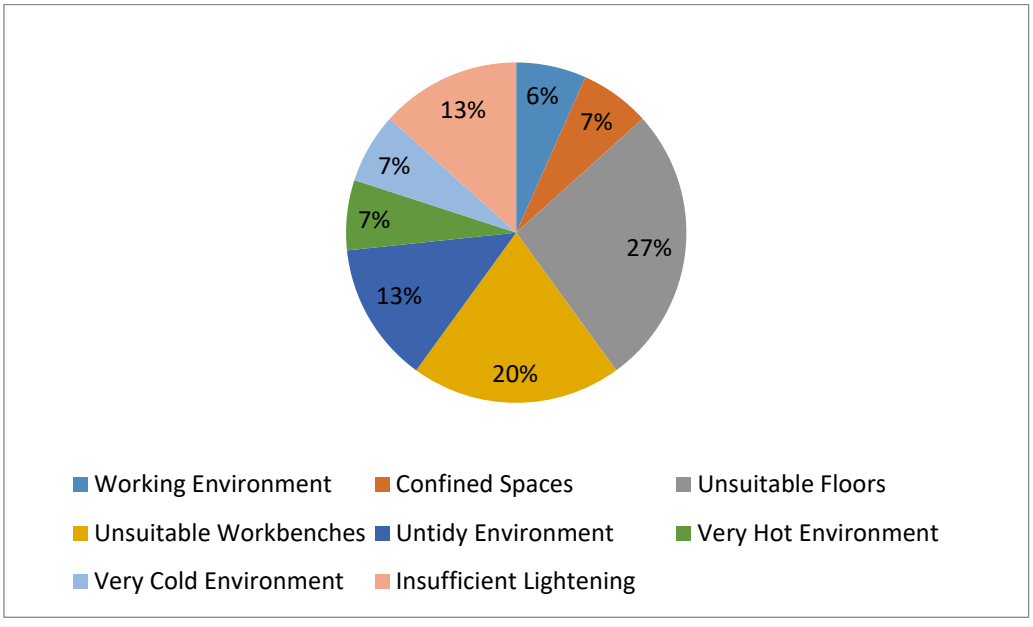


Figure 4.8. Distribution of working environment related risk factors in the area of production by FMEA method

Personal risk factors include the risk factors that are directly related with human. The distribution of personal risk factors are shown on Figure 4.9. It is found as no use of PPE (6), working without obeying rules (3), lack of supervision (2). Lack of supervision, getting sick or tired and repression and stress are found as 1.

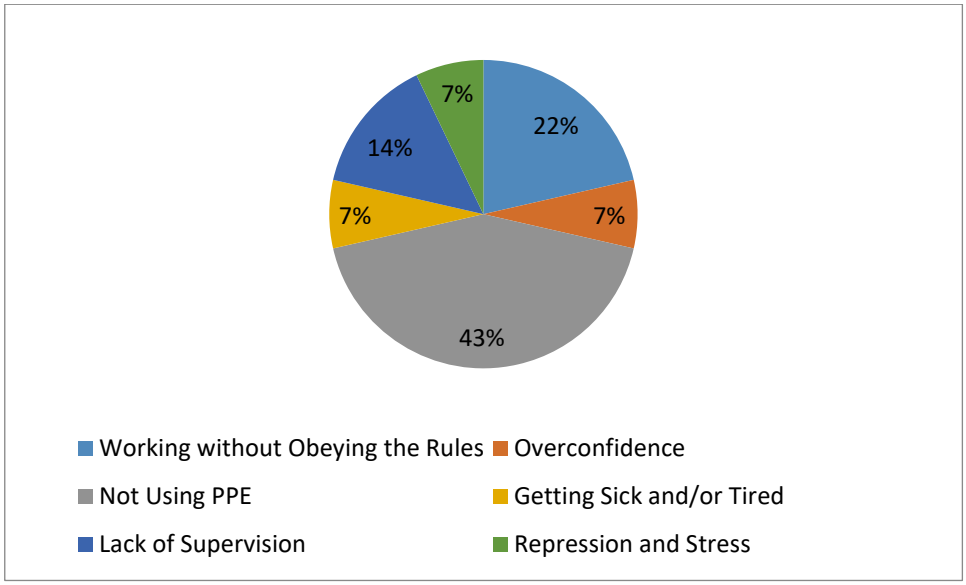


Figure 4.9. Distribution of personal risk factors in the area of production by FMEA method

According to Figure 4.10, the distribution of ergonomic risk factors is like this: 4 improper posture positions, 4 carrying and lifting heavy loads and 2 repetitive work. Ergonomic risk factors are very significant in a meat plant because thermal conditions increases the possibility of failure which is back and waist pain in this case.

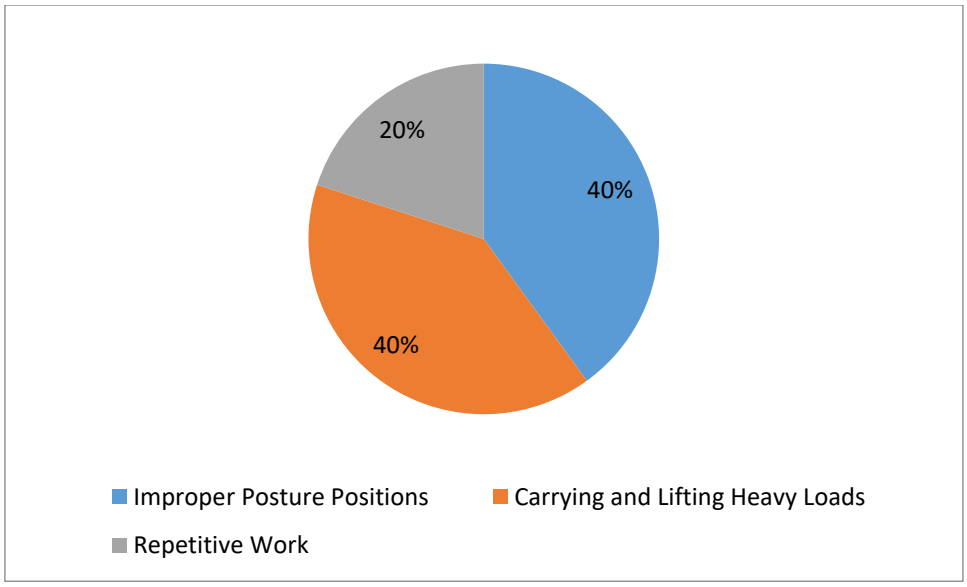


Figure 4.10. Distribution of ergonomic risk factors in the area of production by FMEA method

Ergonomy is examined only for office employees in the facility. However, sausage production line machine operators and packaging line employees are faced with the same ergonomic risks. These risks are taken into consideration separately for each machine by MSRC. Any of the machines and conveyors are adjustable to the height of employees.

In the facility where the thesis study is performed, noise level of production area is measured on some points; however, the noise level of washing area is not measured specifically. A study on meat processing showed that there is high level of noise in washing area (Hamid *et al.*, 2016). The trolleys are collected and washed together in facilities and during this process the noise level is measured and it is found 86 dB. This issue needs to be considered in future studies.

## 4.4 Distribution of Risks on Storage Rooms

In this study storage rooms are accepted as a part of sausage production line. FMEA method is applied to storage rooms. 33 risk factors are found. The distribution of risk factors is shown in Figure 4.11.

Also, the risk priority number is calculated as 91 which is in yellow zone. Although 91 is very close to 100, it cannot be placed in red zone. However, the value ise high so storage rooms must carefully be monitored. Furthermore, the employees are exposed to rapid temperature changes because the sausage production area is cold, but cooking area is hot and humid and finally the storage roooms are cold. Employees goes one place to another many times in a shift.

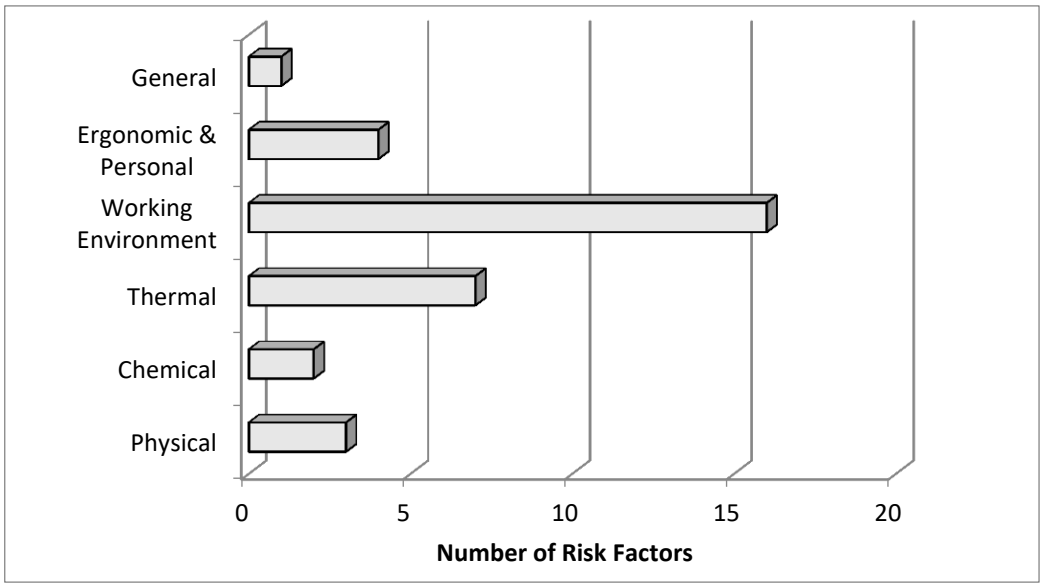


Figure 4.11. Distribution of risk factors in storage rooms by FMEA method

According to risk analysis data on Figure 4.11, 16 working environment risk factors are found in storage rooms. The distribution of these factors are shown on Figure 4.12. Confined spaces and very cold environment risk factors are found 7 for each. In addition, there are 2 insufficient lightening risk factors.

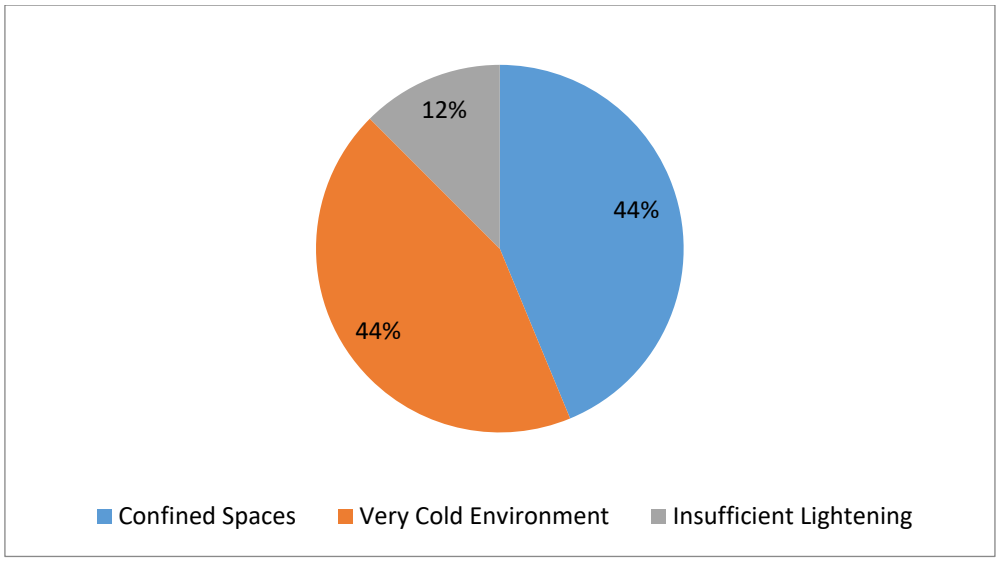


Figure 4.12. Distribution of working environment risk factors in storage rooms by FMEA method

The next most widespread risk factor is thermal because there is both low temperature materials and low temperature environment. 7 thermal risk factors are found. The reason is food safety and it is inevitable. Thus, the exposure must be decreased only by arrangement of shifts and suitable protections from cold.

In this study, it is determined that the employees work without obeying the rules. This constitutes 3 of the 4 personal risk factors in storage rooms. The other one is repression and stress due to time pressure. Figure 4.13 demonstrates the distribution.

This facility interviewed has detailed record of occupational accidents. The distribution of occupational accidents in the facility visited is like this: 53% - falling of product on the employee, 25% - cuts because of the slip of knife, 14% falls due to slip on oily and wet floor, 8% - hand or finger jam during carrying loads or because of moving parts. The results are similar with a study report named “Occupational Safety and Health in the Food and Drink Industries”(Tomoda, 1993) are similar to the statistics above. It has been mentioned that mechanization increases the the speed of work and this situation increases the stress level on the

employees. At the same time, increased muscular-skeletal system disorders as a result of the increase of monotonous and repetitive jobs were reported. Moreover, the more the increase in mechanization, the more hearing loss is experienced by employees. It has also been mentioned that cold working environments are required for the safety of products such as red meat, and therefore the employees experience discomfort such as respiratory diseases, cold bite, rheumatism as a result of exposure to cold. In this study, it is mentioned that sudden temperature changes and cold working environment is both physically and psychologically affect the employees. This report verifies this determination.

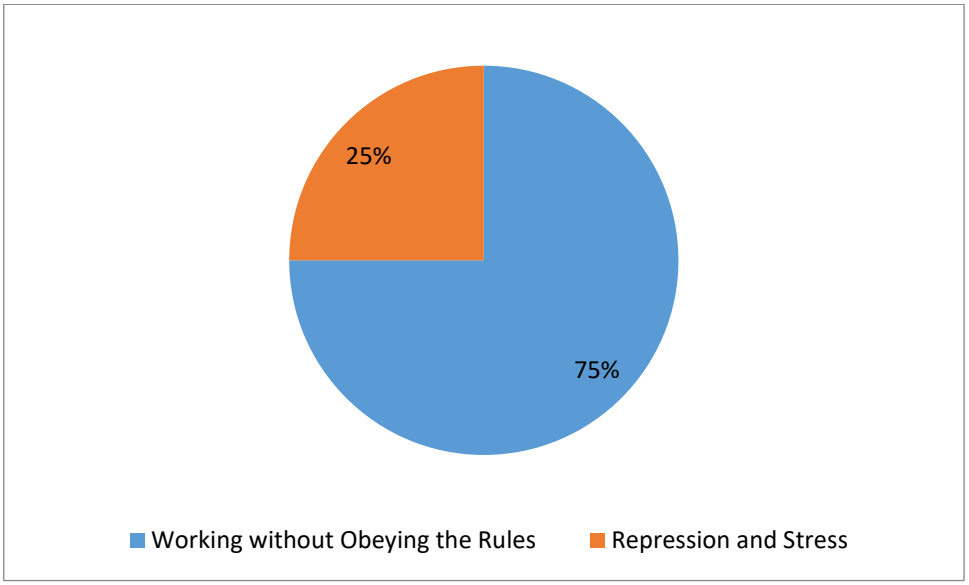


Figure 4.13. Distribution of personal risk factors in storage rooms by FMEA method

## 4.5 Distribution of Risks on Overall Section

In this section, the other risk factors are examined. The risk factors evaluated in this section can be categorized as others because they cannot be involved in any other section in this study. Hydrophore, water tank, fire extinguishers, emergency exit, compressor, pressurized gas cylinder, etc. are examined in terms of risk factors by FMEA method.

The risk priority number is calculated as 97 which is barely in yellow zone. Although the parameters evaluated in this are not directly related with the storage line, any failure in them may effect both the production and employees work for sausage production. That is why it is necessary to include these parameters.

If the distribution of 59 risk factors are examined in detail from Figure 4.14, it is found that physical, general, fire and explosion risk factors have the highest numbers. In general risk factors, wastes, lack of periodic control and lack of emergency measures are taken into account.

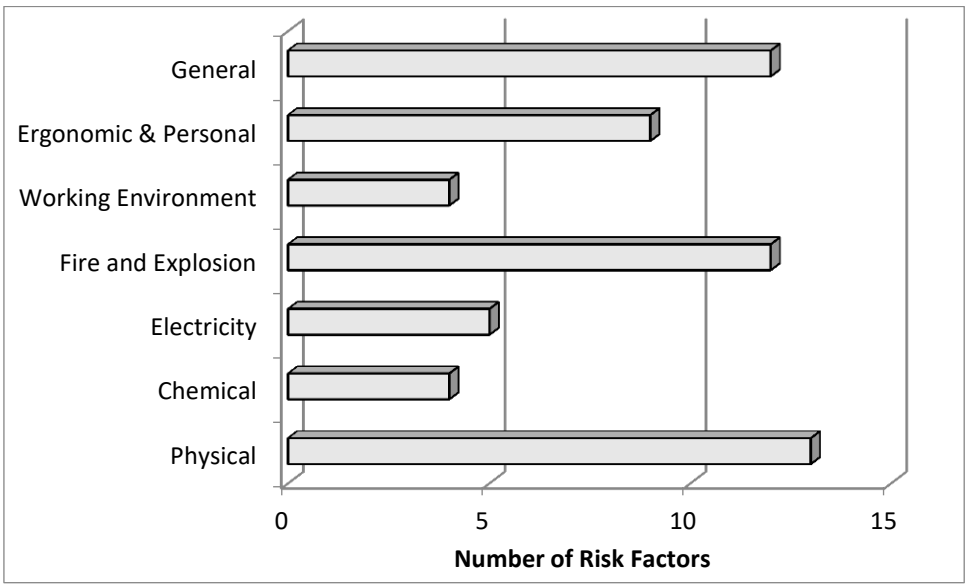


Figure 4.14. Distribution of risk factors in overall section by FMEA method

## 4.6 Distribution of Risks on Vehicles

### 4.6.1 Distribution of Risks on Lifting Devices

Lifting devices are forklifts and transpalets. These are used to carry packaged products to storage rooms and transportation vehicles. As can be seen from Figure 4.15, the number of risk factors are found as 14 and these are working without obeying the rules, overconfidence, lack of supervision and periodic control.

There are significant failures resulted from lifting devices. For instance, forklift or transpalet may hit employees. In addition, the load may fall over and it may harm employees, also the lifting devices may fall over by itself due to unbalanced loading or reckless driving. In this paragraph, all failures have the risk priority number of 108 and they are in red zone; thus, they have the potential of serious injury.

Totally, the risk priority number is found 118 for lifting vehicles. Hence, forklifts and transpalets are in red zone in terms of occupational health and safety risks.

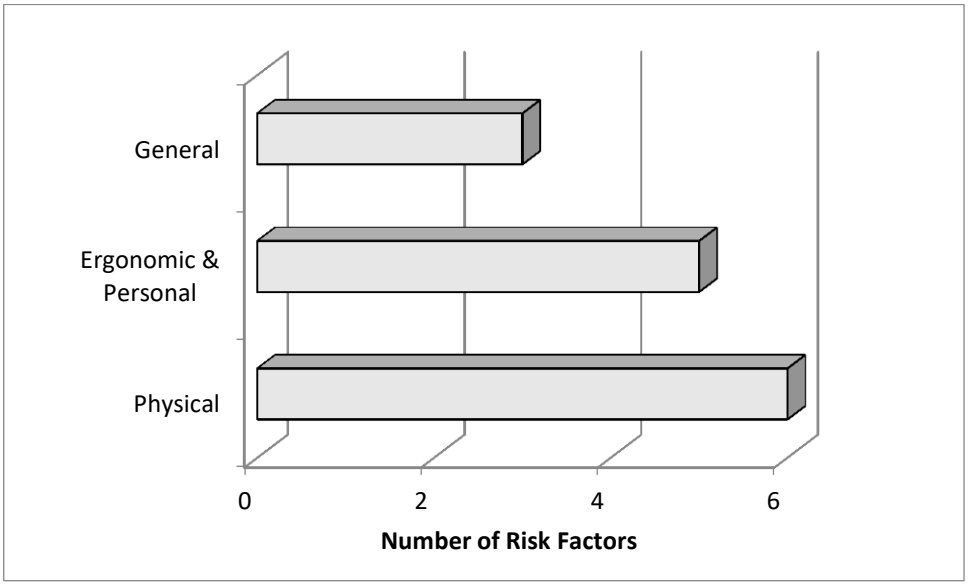


Figure 4.15. Distribution of risk factors in lifting vehicles by FMEA method

Forklifts are also evaluated by MSRC because there is a whole section for moving machines. In case of a crash or fall over, the seat of driver is not safe and driver can fall or stuck. All control units are easily and immediately reachable by driver. There is sound and visual warning signal for backward movement. Forklifts are covered with a protective roof; hence fallen objects may not cause any hazard to the driver. There are 2 identical forklifts, so they are evaluated as one. There is independent emergency stop system if main stop system is failed. Lastly, in case of emergency, battery connection is possible to cut.

### 4.6.2 Distribution of Risks on Transportation Vehicles

The vehicles in this category can be considered as trucks which transports the end product to wholesale and retail stores. Thus, this is the last section of risk assessment of sausage production line.

The risk priority number of transportation vehicles section is calculated. The value is 92 and it is in yellow zone. Moreover, the number of risk factors are 22. The distribution of these risk factors are on Figure 4.16. According to Figure 4.16, 15 of them are related with personal issues such as lack of supervision, overconfidence and working without obeying the rules. Also, there is carrying and lifting heavy loads risk factor. Although forklifts are used for loading the trucks, manual handling is still used. Moreover, the boxes fall over due to irregular stacking. This failure posseses two effects. The first effect of failure is back and waist pain because employees must replace the boxes manually in the truck. The second effect of failure is that the boxes may hit employees and they cause injuries.

Lastly, there is traffic accident risk factor whose effect is injury or death of both employee and people who are involved.

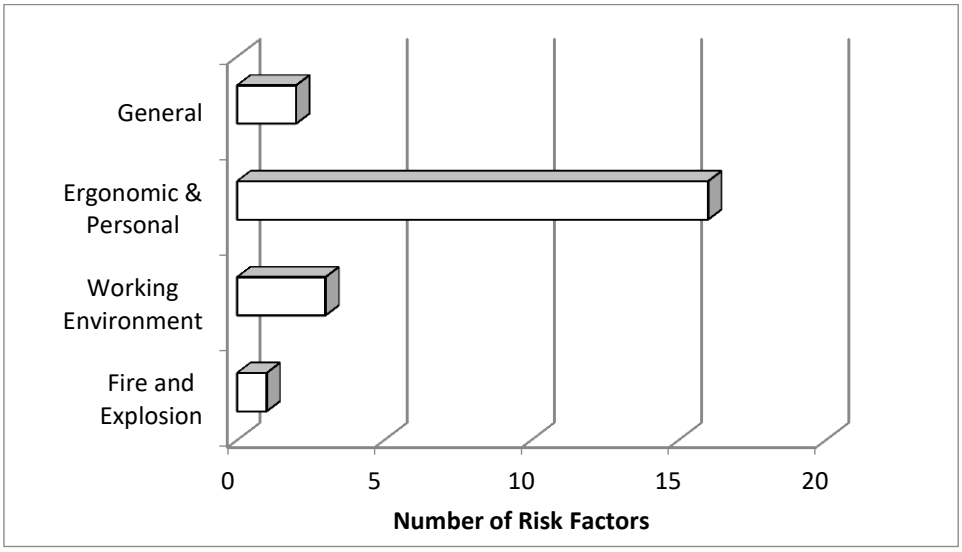


Figure 4.16. Distribution of risk factors in transportation vehicles by FMEA method

## 4.7 Discussion of Limitations and Weaknesses

In this study, machine risk assessment is the main focus; however, all the possible hazards on sausage production line are identified and risk assessment is performed in the light of this comprehensive information. On the other hand, it is observed that there are considerable amount of psychological and biological risk factors which are not well monitored and focused. Biological risk factors may cause occupational diseases, but they are hard to be monitored because it is nearly impossible to relate a disease with working conditions or from the outside. Biological risk is not only observed during field study but also both the veterinarian and occupational safety expert do not deny this issue. The bacterial and fungi infections are not specifically related with employees of meat sector like pneumoconiosis. Solutions should be produced for this issue. Also the employers work at least 8 hours a day in cold environment and do repetitive work. It is inevitable that these conditions may affect the employees psychologically. The psychological disorders of meat workers and their effects to the employees' health and social life can be a main topic to future studies.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

Red meat production sector is one of the sectors in which occupational accidents are frequently observed due to the processes, equipment, materials and physical work load required. This study is aimed to identify hazards and evaluate risks on sausage production line on chosen facility in meat industry. In the context of this study, a field study in a small scale meat production facility is carried out. Based on the qualitative and quantitative analysis on occupational health and safety risk assessments performed, it can be concluded that there are several occupational health and safety risks that employees faced with. Meat sector mostly depends on manpower even in further processing like sausage production, automation cannot be provided. Furthermore, meat and meat products are one of the vital nutritional sources of human. Thus, occupational health and safety of meat sector employees is a very significant issue.

This study clearly illustrates the risks of sausage processing line, but it also raises the question of how they can be handled because machine related risks can be prevented by only design and facilities have no economic power to solve this problem. Moreover, food safety can be a preventive factor for some occupational safety measures. For instance, machines with high level of noise cannot be isolated because of food safety since machines must have smooth surfaces and parts made up of stainless steel. This example lays the emphasis on safe design of machines.

The risk assessment application is done by dividing the sausage production line into 7 sections.

According to the risk assessment 121 risks are found in 6 different sections. 30% of these risks, which is the highest percentage that a section has, are identified in the section of machines. Moreover, there 274 risk factors. The risk factors are considered as root causes of failures of FMEA method. Again, 30% of these risk factors are machine related. Machines are the riskiest part of sausage manufacturing.

## 5.2 Recommendations

Based on these conclusions, recommendations may include 2 parts. The first one is for employees, employers and occupational safety and health professionals. Education and on site training of employees, periodic maintenance of machines and equipment, as safe as possible machines are the most significant recommendations of this study. The second one is for future studies in order to improve the occupational safety and health conditions of employees.

The first recommendation is that the working environment in all facilities should be healthy and safe for the employees (F-7). For this purpose, the ways of ensuring a healthy and safe working environment and those responsible for this important task are clearly stated in our OHS legislation. In this context, comprehensive risk assessment and measurement in enterprises should be performed. According to their results, the risks of occupational accidents and occupational diseases can be minimized firstly by eliminating the risks by design, then, the substitution of the hazardous with the non-hazardous, later, the collective protection and taking the necessary personal measures as the last resort. The suitable PPEs and the necessary areas for the use of PPEs are shown on the measures part of risk assessment tables (F-8). Within the scope of this thesis, the identified hazards and risks and the necessary precautions are shared with the visited red meat production plants. Also, information about current legislation is given. Finally, consultation meeting is hold with occupational safety experts, food engineers, veterinarian and employees in order not to escape any matter.

The second one is for future studies that the psychological and biological risk factors should be studied in detail (F-3, F-8). The research question of future studies may be derived from identification and elimination of these two risk factors because there is not enough information on these two risk factors on the area of meat manufacturing. Also, collecting data from the field is a challenge due to difficulty of monitoring.

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# APPENDICES

## A. Table of Risk Factors

| Risk Factor Code | Category | Sub-Risk Factor Code | Sub-Risk Factor |
|---|---|---|---|
| **F-1** | Physical | 1 | Noise |
| | | 2 | Vibration |
| | | 3 | Moving parts |
| | | 4 | Forklift, transpalet |
| | | 5 | Equipment used (knife etc.) |
| | | 6 | Pressure |
| | | 7 | Object fall |
| **F-2** | Chemical | 1 | Allergens |
| | | 2 | Abrasive materials |
| | | 3 | Harmful to the environment |
| | | 4 | Toxic substances |
| | | 5 | Irritants |
| | | 6 | Acids |
| | | 7 | Cancerogens |
| | | 8 | Solvents |
| **F-3** | Biological | 1 | Bacteria |
| | | 2 | Viruses |
| | | 3 | Fungi |
| | | 4 | Allergens |
| | | 5 | Irritants |
| | | 6 | Prions |
| **F-4** | Thermal | 1 | High-temperature materials |
| | | 2 | Low-temperature materials |
| **F-5** | Electricity | 1 | High voltage |
| | | 2 | Damaged electricity line |
| | | 3 | Static load |
| | | 4 | Short circuit |
| **F-6** | Fire and Explosion | 1 | Combustible materials |
| | | 2 | Inflammable materials |
| | | 3 | Physical explosion |
| | | 4 | Chemical explosion |
| | | 5 | Electricity |

| Risk Factor Code | Category | Sub-Risk Factor Code | Sub-Risk Factor |
|---|---|---|---|
| **F-7** | Working Environment | 1 | Narrow spaces |
| | | 2 | Confined spaces |
| | | 3 | Working at height |
| | | 4 | Unsuitable floors |
| | | 5 | Unsuitable workbenches |
| | | 6 | Untidy environment |
| | | 7 | Very hot environment |
| | | 8 | Very cold environment |
| | | 9 | Working at night |
| | | 10 | Insufficient lightening |
| **F-8** | Ergonomic | 1 | Improper posture positions |
| | | 2 | Carrying and lifting heavy loads |
| | | 3 | Repetitive work |
| | Personal | 4 | Working without obeying the rules |
| | | 5 | Overconfidence |
| | | 6 | Not using PPE |
| | | 7 | Getting sick and / or tired |
| | | 8 | Lack of supervision |
| | | 9 | Repression and stress |
| | | 10 | Absence and forgetfulness |
| F-9 | General | 1 | Structure and building borne |
| | | 2 | Waste |
| | | 3 | Lack of periodic control |
| | | 4 | Lack of emergency measures |
| | | 5 | Other hazards |

The coding of risk factors in risk evaluation matrixes is shown in example below:

Example: Noise: F1-1, Confined spaces: F7-2.

## B. **Risk Assessment Charts**

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | RAW MATERIAL PREPARATION | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F2-1 | Raw material preparation | Allergy | Occupational disease | Working with allergen food additives | | 2 | 5 | 7 | 70 |
| F2<br>F7-2<br>F8-6 | | Difficulty of respiration due to dusty environment | Occupational disease | Inadequate ventilation and misuse of PPE | | 7 | 5 | 2 | 70 |
| F7-4 | | Slippery floor | Slip, trip, fall | Slippery floor due to dust | | 5 | 5 | 2 | 50 |

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | PRODUCTION | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F7-4 | Floors | Unsuitable floors | Slips, trips, falls | The floors are not built for work | There are no cracks, indentations and protrusions on the floors. | 4 | 5 | 3 | 60 |
| F7-6 | Cables | Disorganized cables | Slips, trips, falls | The machines are far from the sockets | Since the socket of each machine is right next to it, there is no scattered cable on the ground. There is a mobile cable used only in case of need. | 2 | 5 | 2 | 20 |
| F5-2<br>F7-6 | | | Electric shock | Worn cables | | 2 | 5 | 2 | 20 |
| F2-2<br>F2-4<br>F2-5<br>F8-8 | Cleaning | Exposure to chemicals | Occupational disease<br>Injury | Lack of labelling of cleaning materials | | 6 | 5 | 2 | 60 |
| F8-2<br>F8-6<br>F8-8 | | | Occupational disease<br>Injury | Not use PPE during cleaning | | 6 | 5 | 2 | 60 |

Risk Assessment of Production (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-5<br>F8-2<br>F8-5 | Knifes | Insecure knife usage | Cuts | Lack of education and PPE | | 8 | 4 | 3 | 96 |
| F1-5<br>F8-2<br>F8-6 | | Leaving the knifes open | Cuts | Leaving the knifes open | The knives whose work is finished are cleaned and placed in the storage areas with the sharp side on top. | 2 | 4 | 3 | 24 |
| F7-4<br>F7-5 | Workbenches | Unsuitable workbenches | Slips, trips, falls | Slipperiness | | 7 | 5 | 3 | 105 |
| F7-4<br>F7-5 | | | Cuts | | | 7 | 4 | 3 | 84 |
| F7-5<br>F8-10 | | | Back-waist pain | Impossible to adjust the workbenches according to employees' height | | 7 | 5 | 3 | 105 |
| F7-10 | Lightening | Unclear vision of employees | Slips, trips, falls | Inadequate lightening | | 4 | 5 | 3 | 60 |
| F7-10 | | | Cuts | | | 4 | 5 | 3 | 60 |
| F5 | Elektric panels | Leakage from electrical panels | Elektric shock | Unsafe electrical panels | | 4 | 5 | 3 | 60 |
| F8-1<br>F8-9 | Carrying and lifting loads | Incorrect lifting of the load | Back-waist pain | Lack of education and equipment | | 7 | 5 | 3 | 105 |
| F8-1<br>F8-9 | | | Fall of the load | | | 7 | 6 | 3 | 126 |
| F8-1<br>F8-9 | | Carrying heavy loads | Back-waist pain | | | 7 | 5 | 3 | 105 |
| F8-1<br>F8-9 | | | Fall of the load | | | 7 | 6 | 3 | 126 |
| F5 | Grounding | No grounding measurement | Electric shock | Lack of instruction-procedure | | 4 | 5 | 3 | 60 |
| F5 | | | Fire | | | 4 | 7 | 3 | 84 |
| F3-1<br>F3-2<br>F7 | Environment | Humidity and moisture formation | Biological risks | Inadequate ventilation | Ventilation system is present. In addition, when the ventilation in the spice room is insufficient, an electric stove is used. | 1 | 5 | 8 | 40 |

Risk Assessment of Production (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-5 | Frozen meat | Cutting of frozen meat | Cuts | Not waiting for the meat to be dissolved / not providing a special machine for this job | Frozen meat is not cut. Meat is cut and finished daily and only frozen grinded meat is used. The grinded meat is left to dissolve before processing. | 1 | 5 | 3 | 15 |
| F1-1<br>F8-6<br>F9-3 | Machines | Noise | Difficulty in communication | Old technology machines, no isolation, not providing suitable hearing protectors for employees | | 8 | 4 | 2 | 64 |
| F1-1<br>F8-6<br>F9-3 | | | Temporary hearing loss | | | 7 | 4 | 3 | 84 |
| F1-1<br>F8-6<br>F9-3 | | | Permanent hearing loss | | | 6 | 2 | 3 | 36 |
| F8-3<br>F8-7 | Employee satisfaction | Employee being stressed | High blood pressure, heart attack, fatigue, dissatisfaction, work accident | Workload, fear of not finishing the work on time, financial difficulties | Rotation is made among some employees. | 4 | 4 | 3 | 48 |
| F7-7<br>F7-8 | Temperature | Rapid temperature changes | Common cold | While the temperature in the cooking area is around 30°C, the temperature is around 5 ° C in the final product packaging and raw meat areas. | | 7 | 4 | 3 | 84 |
| F1-5<br>F8-10 | Knifes | Continuous wrist movement in cold environment | Hand, wrist, elbow pain | Repetitive work of employees using knife | | 7 | 5 | 3 | 105 |

Risk Assessment of Production (continued)

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | OVERALL | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F1-3<br>F1-6<br>F6-3<br>F9-3 | Hydrophores | Explosion of hydrophores | Injury | Not controlling hydrophores | Controls and experiments of hydrophores are performed after production and before installation and start. Also, they are periodically continued yearly. | 1 | 3 | 8 | 24 |
| F3-1<br>F3-2<br>F9-3 | Water tanks | Use of unclean water | Contagious disease and contaminated product | Not doing maintenance of water tanks | Since the water tanks are used continuously, they are in cycle.<br>The cap of the water tanks is tightly closed.<br>There is enough distance to walk around the water tanks to facilitate maintenance and control.<br>Since the water tanks are made of stainless steel material, they can be easily cleaned. | 3 | 4 | 5 | 60 |

Risk Assessment of Overall (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-3<br>F1-6<br>F6-3 | Compressor | Increase of pressure | Explosion | No protection steel cage, no registration card; safety valve and check valve not working. No air intake filter, crankcase leaking oil. | Grounding installation of compressor is present. | 3 | 9 | 9 | 243 |
| F1-3<br>F5 | | Electic leakage | Electric shock | | | 3 | 8 | 9 | 216 |
| F1-3<br>F3-1<br>F3-2 | | Pumping moist and dirty air | Biological Risk | | | 3 | 8 | 9 | 216 |
| F1-3<br>F1-6<br>F5<br>F6-3<br>F9-3 | Periodic maintenance | Improper operation of compressor | Electric shock, fire, explosion | Lack of technical controls of compressor | | 3 | 8 | 9 | 216 |
| F1-5 | Extraction hood | Fall of extraction hood | Impact, crush | Not fixing extraction hood | | 5 | 5 | 3 | 75 |
| F1-5<br>F6-2 | | Ignition of extraction hood | Fire | Not cleaning extraction hood, buildup on oil | | 3 | 7 | 3 | 63 |
| F1-6<br>F6-4<br>F9-3 | Pressure vessels | Pressure decrease/increase of pressure vessels | Fire, explosion | Not checking pressure vessels | | 3 | 8 | 8 | 192 |
| F1-6<br>F6-4<br>F9-3 | | Leakage from pressure vessels | | | | 3 | 8 | 8 | 192 |
| F6-4<br>F8-2 | | Tipping of pressure vessels | Fire, explosion | Not fixing pressure vessels | | 3 | 8 | 8 | 192 |
| F6-3<br>F9-3 | Fire extinguishing devices | No fire intervention | The growth of fire | Periodic controls of fire extinguishers are not performed. | | 6 | 7 | 2 | 84 |
| F7-6<br>F8-2 | | No fire intervention | The growth of fire | Fire extinguishers are easy to access, not available in suitable places | | 6 | 7 | 2 | 84 |

Risk Assessment of Overall (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F7-1<br>F7-6 | Fire extinguishing devices | Fire extinguishers block the way | Slips, trips, falls | Fire extinguishers are not properly installed. | | 6 | 5 | 2 | 60 |
| F7-6<br>F8-2 | | No intervention to fire | The growth of fire | | | 6 | 7 | 2 | 84 |
| F1-5<br>F8-2 | | Spread of the fire | The growth of fire | Fire cylinders without proper content | | 6 | 8 | 2 | 96 |
| F1-3<br>F6-5<br>F9-3 | Generator | Generator malfunction | Fire, injury | Jeneratörün periyodik bakımının yapılmaması | | 3 | 7 | 4 | 84 |
| F1-3<br>F6-5<br>F8-2<br>F8-5<br>F8-8 | | Operation of the generator by unauthorized persons | Fire, injury | Lack of education | | 3 | 7 | 4 | 84 |
| F6-4 | LPG tubes | LPG leakage | Explosion | No check of LPG tubes and no detector of LPG | | 4 | 8 | 4 | 128 |
| F8-8 | First aid cabinets | Failure to intervene the injured | Loss of blood of injured person | Improper first aid cabinets | | 6 | 4 | 2 | 48 |
| F5 | Electric sockets | Ungrounded sockets | Electric shock | Lack of instruction-procedure | All sockets except the extension cables used in offices are grounded. | 3 | 5 | 2 | 30 |
| F5<br>F6-5 | | Ungrounded sockets | Fire | | | 2 | 7 | 2 | 28 |
| F6-5 | Lamps | Dust forming arc in the lamp socket | Fire | Lamps are open and uncleaned. | Indoor led lighting is available. | 1 | 1 | 2 | 2 |
| F9-4 | Emergency exit routes | Emergency exit routes are not suitable | Failure to evacuate in an emergency | Inadequate emergency plan | | 6 | 7 | 2 | 84 |
| F9-4 | | | Slips, trips, falls | | | 6 | 7 | 2 | 84 |
| F8-2<br>F9-4 | | No emergency drill | Failure to evacuate in an emergency | Not implementing the emergency plan | | 6 | 7 | 2 | 84 |

Risk Assessment of Overall (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F9-4 | Fire extinguishing system | No fire intervention | The growth of fire | Yangın söndürme sisteminin yetersiz olması | There are fire alarm buttons and smoke detectors.<br>There is no fire extinguishing system other than fire extinguishing devices. | 7 | 7 | 2 | 98 |
| F9-2 | Wastes | Storage of hazardous waste | Exposure to chemicals | Improper storage of hazardous waste | Hazardous waste storage area is surrounded by wire and there are paving stones. Warning signs are present. Its wall is connected to the panel wall of the boiler room. | 4 | 5 | 3 | 60 |

Risk Assessment of Overall (continued)

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | MACHINES | | |

| No | PROCESS / PIECE | TYPE OF FAILURE | EFFECT OF FAILURE | REASON OF FAILURE | PRESENT CONTROL MEASURES | Probability | Severity | Detectability | Risk Priority Number |
|---|---|---|---|---|---|---|---|---|---|
| F1-3 | Cuter | Contact with moving parts | Injury<br>Loss of limb | Operating cuter with open cover | | 7 | 7 | 5 | 245 |
| F1-3<br>F1-7 | Bandsaw | Object splash | Injury<br>Loss of eye | Bone splash | | 7 | 6 | 4 | 168 |
| F1-3<br>F8-6 | | No machine protectors | Injury<br>Loss of limb | Contact with moving blade | | 7 | 7 | 5 | 245 |
| F4-2 | | Long time contact with cold material | Occupational disease | Cutting frozen meat | | 7 | 5 | 5 | 175 |
| F1-3 | Homogenizator | Contact of employee with the moving parts | Injury<br>Loss of limb | Manual intervention while working | | 7 | 7 | 5 | 245 |
| F1-3 | Small grinder | Contact with the moving parts | Injury<br>Loss of limb | Manual intervention while feeding the machine | | 7 | 7 | 5 | 245 |
| F1-3 | Grinder 1 | Contact with the moving parts | Injury<br>Loss of limb | Manual intervention while feeding the machine<br>No continuous cleaning | | 7 | 7 | 5 | 245 |

Risk Assessment of Machines (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-3 | Sausage Filler Machine | Contact with moving parts | Injury<br>Loss of limb | Manual intervention while feeding | | 7 | 7 | 5 | 245 |
| F1-3<br>F1-7<br>F8-3 | | Tipping of feeding trolley | Injury<br>Loss of limb | Improper installation of the feed trolley | | 3 | 7 | 8 | 168 |
| F1-3 | | Contact with moving parts | Injury<br>Loss of limb | Unsafe cleaning while machine is operating | | 7 | 7 | 5 | 245 |
| F3-1<br>F3-3<br>F7-7 | Cooking rooms | Moisture and humidity formation | Biological risks | Inadequate ventilation | When the product is removed in sausage cooking rooms, there is intense steam. Outside this area, ventilation is sufficient. | 2 | 5 | 8 | 80 |
| F7-1<br>F7-2<br>F8-3 | | Stuck in narrow and confined spaces | Biological risks<br>Exposure to cleaning chemicals<br>Psicological risks | Inadequate ventilation | It is possible to open the doors from the inside. | 6 | 4 | 4 | 96 |
| F4-1<br>F7-1<br>F7-2<br>F7-7<br>F8-3<br>F8-5 | | Early entrance of employee to the room and contact with the walls | Burns | No lock system to prevent opening the doors | | 4 | 5 | 5 | 100 |
| F1-3 | Labeling machine | Contact with moving parts | Injury | No machine protectors | | 6 | 4 | 4 | 96 |
| F5 | Residual current relay | Excess current to the machine | Electric shock | No residual current relay on machines | There is residual current relay on the main line. | 3 | 3 | 6 | 54 |
| F1-3<br>F8-8 | Machine usage instructions | Misuse of machines | Property damage and injury | Impossible to reach machine operating instructions on site by operator | | 5 | 4 | 6 | 120 |
| F1-3<br>F8-2 | | Misuse of machines | Property damage and injury | Operator not reading machine operating instructions | | 5 | 4 | 6 | 120 |

Risk Assessment of Machines (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-3<br>F9-3 | Periodic maintenance | Contact with moving parts | Injury<br>Loss of limb | Employees try to intervene because regular maintenance of machşnery and equipment is not performed | | 5 | 6 | 5 | 150 |
| F1-3<br>F8-9 | Molds of thermoform | Carrying and lifting heavy loads | Back, waist pain | Molds of thermoform is heavier than 30 kg | The machine has an apparatus for carrying and lifting molds, but it is not used because it is very bulky. | 5 | 4 | 6 | 120 |
| F1-3<br>F8-9 | Rolls of thermovac | Carrying and lifting heavy loads | Back, waist pain | Rolls of thermovac is heavier than 25-30 kg | | 5 | 4 | 6 | 120 |
| F1-3<br>F4-1 | Pressurized water / air equipment used for cleaning | Contact with hot steam | Burns | Loss of control of hose | | 6 | 5 | 3 | 90 |
| F1-3 | | Hose hitting the employee | Slips, trips, falls | | | 6 | 5 | 3 | 90 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | Vacuum packaging machine | Noise level 81 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | | 7 | 4 | 2 | 56 |
| F1-1F1-3F8-6F9-3 | | | Temporary hearing loss | | | 6 | 4 | 3 | 72 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Permanent hearing loss | | | 5 | 6 | 3 | 90 |

Risk Assessment of Machines (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F1-3 | Conveyors at the exit of packaging machine | Finger jam | Injury<br>Loss of limb | No protector on the conveyor at the exit of extruder | | 7 | 7 | 5 | 245 |
| F1-3<br>F8-2 | Protective parts of machines | Contact with moving parts | Injury<br>Loss of limb | Employees working by damaging the protective parts of machines | | 7 | 7 | 5 | 245 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | Grinder 2 | Noise level is 90 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | | 8 | 4 | 2 | 64 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Temporary hearing loss | | | 7 | 4 | 3 | 84 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Permanent hearing loss | | | 6 | 6 | 3 | 108 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | Sausage peeler machine | Noise level 92 dB | Communication difficulties | Old technology machines, inadequate isolation, not providing appropriate PPE to employees | | 8 | 4 | 2 | 64 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Temporary hearing loss | | | 7 | 4 | 3 | 84 |
| F1-1<br>F1-3<br>F8-6<br>F9-3 | | | Permanent hearing loss | | | 6 | 6 | 3 | 108 |

Risk Assessment of Machines (continued)

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | STORAGE ROOMS | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F4-2<br>F7-2<br>F7-8 | Doors of cold storage rooms | Employee stuck inside | Hypothermia | The doors of cold storages are not suitable | It is possible to open the doors from the inside of cold storage rooms. | 1 | 5 | 4 | 20 |
| F4-2<br>F7-2<br>F7-8<br>F7-10 | Lightening of cold storage rooms | Employee stuck inside | Hipotermi | Unsuitable lightening in cold storage rooms | | 6 | 5 | 4 | 120 |
| F4-2<br>F7-2<br>F7-8<br>F7-10 | | | Slip, trip, fall | | | 6 | 5 | 4 | 120 |
| F4-2<br>F1-4<br>F8-2 | Forklift and pallet truck | Pedestrian crash | Crush | Failure to use forklifts correctly and their roads are not specified. | | 4 | 6 | 3 | 72 |
| F7-2<br>F7-8 | Alarm | Employee stuck inside | Hypothermia | Lack of alarm system in cold storage rooms | | 6 | 5 | 4 | 120 |
| F4-2<br>F7-2<br>F7-8 | Cold storage rooms (-18 C ) | Exposure to cold | Common cold | Precautions to protect employees from cold are not taken. | | 8 | 7 | 2 | 112 |

Risk Assessment of Storage Rooms (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F4-2<br>F7-2<br>F7-8 | Cold storage rooms (-40 C ) | Exposure to cold | Common cold | Precautions to protect employees from cold are not taken. | | 8 | 7 | 2 | 112 |
| F4-2<br>F7-2<br>F7-8<br>F9-3 | Safety measures of cold stores | Employee stuck inside | Hypothermia | Failure to maintain the security measures in cold storages | | 3 | 5 | 3 | 45 |
| F1-5<br>F8-2 | Shelves | Tipping of shelves | Tipping on the employee | Shelves not being fixed on the wall | Shelves are fixed on the wall. | 5 | 6 | 3 | 90 |
| | | | Hypothermia | | | 4 | 5 | 3 | 60 |
| F1-5<br>F8-2 | | Tipping of shelves | Tipping on the employee | Unbalanced loading on shelves | The maximum weight that the shelves can carry is written on them. | 7 | 5 | 3 | 105 |
| | | | Hypothermia | | | 5 | 5 | 3 | 75 |
| F8-3 | Employee satisfaction | Stress of employee | High blood pressure, heart attack, fatigue, dissatisfaction, occupaational accident | Workload, fear of not finishing the work on time, financial difficulties | Rotation is made among some employees. | 4 | 4 | 3 | 48 |
| F2-3<br>F2-4 | Cooling system | Ammonia leakage | Inhalation by the employee | Suffocation | | 3 | 7 | 8 | 168 |

Risk Assessment of Storage Rooms (continued)

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | LIFTING DEVICES | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F1-4<br>F8-2 | Forklift and pallet truck | Tipping of the load | Tipping on employees | Irregular stacking | | 6 | 6 | 3 | 108 |
| F1-4<br>F8-2<br>F8-5 | | Tipping of vehicle | Tipping on employees or crush of operator | Improper use of lifting vehicles | | 6 | 6 | 5 | 180 |
| F1-4<br>F8-8<br>F9-3 | | Pedestrian crash | Crush | Failure to use forklifts correctly and their roads are not specified. | | 4 | 6 | 3 | 72 |
| F1-4<br>F9-3 | Periodic maintenance | Tipping of the load | Çalışanın üzerine devrilmesi | Failure of lifting devices due to lack of periodic maintenance and employee trying to fix by himself | | 6 | 6 | 3 | 108 |
| F1-4<br>F8-2<br>F9-3 | | Contact of employee with the moving parts | Injury | | | 5 | 6 | 5 | 150 |
| F1-4 | Marking of forklift and pallet truck | Contact of employee with the moving parts | Injury | Failure to mark the auxiliary parts of the lifting devices, including the connections, fixing and supporting elements | | 3 | 6 | 5 | 90 |

| FMEA<br>RISK EVALUATION FORM | | | | | EVALUATOR | ŞENİZ BİÇER | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | DATE | | | | |
| | | | | | DEFINITION OF SECTION / PROCESS | VEHICLES | | | |
| | | | | | | | | | |
| **No** | **PROCESS / PIECE** | **TYPE OF FAILURE** | **EFFECT OF FAILURE** | **REASON OF FAILURE** | **PRESENT CONTROL MEASURES** | **Probability** | **Severity** | **Detectability** | **Risk Priority Number** |
| F8-2<br>F8-5 | Driving of vehicles | Traffic accident | Injury, death | Not obeying the rules while driving | | 3 | 7 | 7 | 147 |
| F8-8<br>F8-2<br>F8-5 | | Traffic accident | Injury, death | Not having driver licence | | 6 | 7 | 3 | 126 |
| F8-8 | | Traffic accident | Injury, death | Driving of vehicles by unauthorized people | | 3 | 7 | 4 | 84 |
| F8-2<br>F8-5<br>F8-8 | | Pedestrian crash | Injury, death | Tesis içindeki araçların hızlı gitmesi | | 6 | 7 | 3 | 126 |
| F6-3<br>F8-8<br>F9-4 | Fire extinguishers | Failure to interfere with fire | Growth of fire, explosion | No fire extinguisher in the vehicle | | 6 | 7 | 2 | 84 |

Risk Assessment of Vehicles (continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| F8-4<br>F8-7 | Vehicle loading-unloading | Employee crash | Injury, death | As a result of not controlling the vehicles after loading-unloading, product spills from the open door, hitting the employee, etc. | | 6 | 7 | 3 | 126 |
| F8-8 | | Vehicle overturning | Injury, death | Irregular stacking of the vehicle | | 3 | 7 | 3 | 63 |
| F9-1<br>F7-10 | | Pedestrian crash | Crush | Blind spots not visible while parking the vehicle | | 5 | 7 | 2 | 70 |
| F8-2<br>F8-5 | Employee services | Traffic accident | Injury, death | Employee services do not follow the rules | | 3 | 7 | 2 | 42 |
| F7-1<br>F7-2<br>F8-3 | Employee satisfaction | Stress of employees | High blood pressure, heart attack, fatigue, dissatisfaction, occupaational accident | Workload, fear of not finishing the work on time, financial difficulties | Rotation is made among some employees. | 4 | 4 | 3 | 48 |

Risk Assessment of Vehicles (continued)

## C. Checklists of Machines

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Cuter |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |

Machine Safety Regulation Checklist of Cuter (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |
| | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | | No | |
| | | Energy source connection is locked while maintenance and repair continues. | | No | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Cuter (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Cuter (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Grinder1 |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Grinder1 (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | | No | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Grinder1 (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Grinder1 (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Grinder2 |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Grinder2 (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | Yes | | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | | No | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | | No | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Grinder2 (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Grinder2 (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Small Grinder |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Small Grinder (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | | No | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Small Grinder (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | Yes | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Small Grinder (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Homogenizator |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Homogenizator (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | Yes | | |
| | | Machine cannot be started unless the protections are locked. | Yes | | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Homogenizator (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | Yes | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Homogenizator (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Sausage Filler |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Sausage Filler (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | Yes | | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Sausage Filler (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | Yes | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Sausage Filler (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Sausage Peeler Machine |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | Yes | | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Sausage Peeler Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | Yes | | |
| | | Machine cannot be started unless the protections are locked. | Yes | | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | | No | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Sausage Peeler Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | Yes | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Sausage Peeler Machine (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Cooking Rooms |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | | NA |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | | NA |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | | No | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Cooking Rooms (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | Yes | | |
| | | Machine cannot be started unless the protections are locked. | Yes | | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | Yes | | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Cooking Rooms (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | | NA |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Cooking Rooms (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Bandsaw |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | Yes | | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | | No | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | No | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | | No | |

Machine Safety Regulation Checklist of Bandsaw (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | | No | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | | No | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Bandsaw (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | | NA |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Bandsaw (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Labeling Machine |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Labeling Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Labeling Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | Yes | | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Labeling Machine (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Packaging Machine |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Packaging Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Packaging Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Packaging Machine (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Vacuum Packaging Machine |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Vacuum Packaging Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | | No | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Vacuum Packaging Machine (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Vacuum Packaging Machine (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Conveyors |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | | No | |
| | Working Positions | Operator can avoid long-term monitoring | Yes | | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | | No | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | Yes | | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | | No | |
| | | If the protective devices are not fully active, machine stops automatically. | Yes | | |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Conveyors (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | | No | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | Yes | | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | Yes | | |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Conveyors (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | No | |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | | | NA |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | | NA |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | | | NA |
| | | There is sound warning signal for backward movement. | | | NA |
| | | There is visual warning signal for backward movement. | | | NA |
| | Operation | The machine does not move unintentionally. | | | NA |
| | Moving | There is independent emergency stop system if main stop system is failed. | | | NA |
| | | In case of emergency, battery connection is possible to cut. | | | NA |
| | Fallen Objects | Machine is covered with a protective roof. | | | NA |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Conveyors (continued)

| Machine Safety Regulation Checklist | Prepared by | Şeniz Biçer |
|---|---|---|
| | Date | |
| | Machine Name | Forklifts |

| Main Parameter | Control Topic | Control List | Applicable | | Not Applicable |
|---|---|---|---|---|---|
| | | | Yes | No | NA |
| Ergonomics | General Ergonomic Topics | Machine is adjustable to the physical characteristics of the operator. | Yes | | |
| | Working Positions | Operator can avoid long-term monitoring | | No | |
| | Sitting Positions | Machine includes suitable sitting equipment for the operator. | Yes | | |
| Control Systems | Safety of Control Systems | A failure in software and hardware in control systems do not cause hazardous situations | | No | |
| | | Predictable human failures do not cause hazardous situations | | No | |
| | | Machine does not start unexpectedly. | Yes | | |
| | | If the protective devices are not fully active, machine stops automatically. | | | NA |
| | Control Units | When stop command is given, machine stops immediately. | Yes | | |
| | Start-Stop | Machine can only be started on purpose with a specific button | Yes | | |
| | | When machine is stopped the energy of activator mechanism is cut. | Yes | | |
| | | Emergency stop button is clearly recognizable, clearly visible and quickly accessible. | Yes | | |
| Mechanical Hazards | Risk of rupture during operation | Machines and various parts of their connections can withstand the stresses they face during operation. | Yes | | |
| | Risk resulted from fallen and splashed parts | Precautions are taken to prevent risks from falling or splashing parts. | Yes | | |

Machine Safety Regulation Checklist of Forklifts (continued)

| | | | | | |
|---|---|---|---|---|---|
| Mechanical Hazards | Risk resulted from surfaces, sides or edges | As long as the purpose of machine allows, machine does not have sharp edges, sharp corners and rough surfaces. | Yes | | |
| | Risk related with moving parts | Moving parts of machine is closed or protected. | | No | |
| | | Machine cannot be started unless the protections are locked. | | No | |
| Noise | | Machine is operating with the noise level of lowest exposure limits. | Yes | | |
| | | Machine is isolated in order to lower noise value. | Yes | | |
| Vibration | | Machine is operating under daily exposure limit value of vibration for hand-arm. | Yes | | |
| Maintenance and repair | Isolation of energy source | Energy is cut before maintenance and repair. | Yes | | |
| | | The machine is completely isolated from the energy source during maintenance and repair. | Yes | | |
| | | Energy source connection is locked while maintenance and repair continues. | Yes | | |
| | | After the energy is cut, the energy normally left or stored in the circuits of the machines wipes out causing any risk to employees. | Yes | | |
| | Intervention of operator | Machine is designed to operate with minimum intervention of operator. | | No | |
| | Cleaning of Inner Parts | Machine is designed to allow minimum product spread to inner parts. | | | NA |
| Machine Instruction Manuals | Preparation | Machine has instruction manual prepared in Turkish. | Yes | | |
| | Content | Information on setting and maintenance work is present. | Yes | | |
| | | Description of the aim and details of use is present. | Yes | | |
| | | Operation method in case of an accident or failure is present. | Yes | | |

Machine Safety Regulation Checklist of Forklifts (continued)

| | | | | | |
|---|---|---|---|---|---|
| Food Machines | Biologic risks | Machine is designed to avoid infection, disease and contagious disease risks. | Yes | | |
| | | Surfaces are smooth. | Yes | | |
| | | There is not any protrusion or holes where organic compounds can place. | Yes | | |
| | | Any substance on the machine including the grease never contact with food. | Yes | | |
| | Cleaning Instructions | Detachable parts are easily be removed and attached. | | | NA |
| | | All cleaning chemicals are easily be cleaned out without any residues. | Yes | | |
| Moving Machines | Position of Driver | Driver has clear vision. | Yes | | |
| | | In case of a crash or fall over, the seat of driver is safe ie. driver cannot fall or squeeze. | | No | |
| | Control Systems | Remote controller is specified to one machine. | | | NA |
| | | All control units are easily and immediately reachable by driver. | Yes | | |
| | | There is sound warning signal for backward movement. | Yes | | |
| | | There is visual warning signal for backward movement. | Yes | | |
| | Operation | The machine does not move unintentionally. | Yes | | |
| | Moving | There is independent emergency stop system if main stop system is failed. | Yes | | |
| | | In case of emergency, battery connection is possible to cut. | Yes | | |
| | Fallen Objects | Machine is covered with a protective roof. | Yes | | |
| Fire | | Machine is safe against any risk of fire or overheating caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |
| Explosion | | Machine is safe against any risk of explosion caused by the machine itself or by the gas, fluid, dust, steam, or any other substance used or produced by the machine. | Yes | | |

Machine Safety Regulation Checklist of Forklifts (continued)