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RISK ASSESSMENT APPLICATION IN MILLING MACHINES

Hamdi Emre BAĞIRAN[1*]

[1] İstanbul Aydın Üniversitesi, Anadolu Bil Meslek Yüksekokulu, İş Sağlığı ve Güvenliği (UE) Programı
ORCID No : http://orcid.org/0000-0003-2395-9700

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Abstract

Machine tools, which are indispensable parts of the machinery and metal production sector, are frequently used in the sector. Workplaces in the sector are in dangerous and very dangerous classes in terms of their activities, and therefore, it is inevitable that work accidents and occupational diseases occur frequently in machine tools where production is made. For this reason, risk assessment has become the most important requirement in order to minimize the physical, chemical and ergonomic risks that already exist in machine tools and originate from use, and to establish an occupational health and safety climate in the sector. In this study, universal and CNC (Computer Numerical Control) controlled milling machines, which are used in a university laboratory, where most of the production is carried out in the sector and therefore one of the most frequently used machine tools, are discussed and risk assessment with Fine-Kinney method, which is one of the most frequently used risk assessment methods in the sector has been made. A total of 23 risks have been identified, corrective/preventive actions necessary to prevent existing hazards and reduce risks have been explained and solutions have been presented. With this study, it is aimed to raise the necessary awareness to the employees by evaluating the milling machines, which are frequently used in the sector, both in production and in the laboratories for educational purposes, in terms of occupational health and safety.

FREZE TEZGAHLARINDA RİSK DEĞERLENDİRME UYGULAMASI

Anahtar Kelimeler

İş sağlığı ve güvenliği
Risk değerlendirme
Metal işleme
Freze tezgahları
Ergonomi

Öz

Makine ve metal üretim sektörünün vazgeçilmez parçaları olan takım tezgahları sektörde sıklıkla kullanılmaktadır. Sektördeki işyerleri faaliyetleri bakımından tehlikeli ve çok tehlikeli sınıflarda yer almaktadır ve dolayısıyla üretimin yapıldığı takım tezgahlarında sıklıkla iş kazaları ve meslek hastalıklarının meydana gelmesi kaçınılmaz bir hale gelmektedir. Bu nedenle, takım tezgahlarında hali hazırda var olan ve kullanımdan kaynaklı fiziksel, kimyasal ve ergonomik riskleri en aza indirebilmek ve sektörde iş sağlığı ve güvenliği iklimini yerleştirebilmek adına risk değerlendirmesi en önemli gereksinim haline gelmiştir. Bu çalışmada bir üniversite laboratuvarında kullanılan, sektörde üretimin büyük kısmının gerçekleştirildiği ve dolayısıyla en sık kullanılan takım tezgahlarından biri olan universal ve CNC (Computer Numerical Control) kontrollü freze tezgahları ele alınmış ve sektörde en sık kullanılan risk değerlendirme yöntemlerinden olan Fine-Kinney yöntemi ile risk değerlendirmesi yapılmıştır. Toplamda 23 adet risk tespit edilmiş, mevcut tehlikelerin önlenmesi ve risklerin azaltılması için gerekli düzeltici/önleyici faaliyetler açıklanmış ve çözüm önerileri sunulmuştur. Yapılan bu çalışma ile sektörde sıklıkla kullanılan freze tezgahlarının hem üretim hem de laboratuvarlarda eğitim amaçlı kullanımında, iş sağlığı ve güvenliği açısından değerlendirilerek, çalışanlara gerekli farkındalığın kazandırılması amaçlanmıştır.

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* Sorumlu yazar e-posta: emrebagiran@aydin.edu.tr

1. Introduction

Technological developments that have been going on for years have paved the way for fast and efficient production in the sectors. Changing production processes with the effect of mechanization has seriously increased the use of machinery equipment, which has dangers and risks for the health and safety of employees. Ignoring the necessary protective equipment and safe working measures due to intensive production processes brings with it unsafe working environments and risks. Therefore, in addition to the great advantages it contains, it is of great importance to address not only the positive aspects but also the negative aspects of technology and to take the necessary precautions to avoid being affected by these negativities. In cases where these precautions are not taken, the risk of contracting an occupational disease increase, and occupational accidents result in injury or death. Especially in the machinery and metal production sector, hundreds of thousands of workers may face the risk of losing their limbs or losing their lives as a result of work accidents and occupational diseases every year. It is inevitable that not only the employee, but also the employee's family, the employer, the society, and therefore the production economy will be negatively affected by this situation. For this reason, it is necessary to prioritize occupational safety in order to advance in the field of production, increase efficiency and quality, and prevent dangers and risks that may cause negative result.

In the report "Safety and Health at the Heart of the Future of Work" by the International Labor Organization (ILO), it is stated that 380,000 workers die in occupational accidents and 374,000,000 workers are injured every year (ILO, 2019). There are also economic losses as well as the loss of life of employees who suffer from work accidents. According to ILO estimates, this financial loss amounts to 4% of gross domestic product globally. While this rate is around 1% of the country's gross product in countries where the occupational health and safety system is prioritized, it can reach up to 6% in countries where the occupational health and safety system is not good. In 2020, there were 2,735,566 non-fatal occupational accidents resulting in at least four calendar days of absenteeism in the member states of the European Union. The number of fatal occupational accidents was announced as 3,355. In the fabricated metal products manufacturing sector, while the number of non-fatal work accidents was 99,251, the number of fatal work accidents was 82 (Eurostat, 2020). In the United States, 2.7 million non-fatal workplace injuries and illnesses were reported in 2020. Of these, 545 thousand were registered as non-fatal occupational diseases. The number of fatal injuries at work was reported as 4764. The number of people who died as a result of work accidents in the fabricated metal products manufacturing sector was 53. While the number of nonfatal occupational injuries and illnesses involving days away from work in all occupational groups was 1,176,340, this number was announced as 16540 in the fabricated metal products manufacturing sector. While the number of occupational accidents involving machine tool cutting setters, operators, and tenders was 3,020, 240 of these were milling and planing machine setters, operators, and tenders (BLS, 2020). When our country is evaluated in terms of occupational health and safety, it is possible to say that it is not at the desired level yet. Considering the highest number of fatal occupational accidents in the world, Turkey comes after India and Russia (Ceylan et al., 2022). This is an indicator of Turkey's occupational health and safety performance. According to the data announced by the Social Security Institution [SGK], a total of 1240 people died in 384605 work accidents that took place in our country in 2020. In addition, 909 people were diagnosed with occupational disease. The number of people who died due to occupational diseases in the same year was announced as 5. Considering the sector, the number of work accidents in the fabricated metal products manufacturing sector is 22765, the number of deaths as a result of work accidents is 20 and the number of workers caught in occupational diseases is 44. According to these data, the manufacturing of fabricated metal products is the second sector with the highest number of occupational accidents after the construction sector (SGK, 2020). Considering the unregistered employment and the number of unreported work accidents and occupational diseases, it is estimated that the actual rates are higher than stated (Karadeniz, 2012; Yağımlı & Ergin, 2017). When the data is examined, it is seen that the machinery equipment and metal products production sector ranks high among the activity groups in terms of work accidents and occupational diseases. Although the number of occupational accidents in the sector is high, the number of fatal occupational accidents is low compared to other sectors. This causes the occupational health and safety risks in the sector to be ignored. As a result of this, a large number of serious accidents occur due to the dangers and risks that are ignored in the sector, and this supports the fact that it is one of the sectors with the highest number of occupational accidents. In this case, what needs to be done is to determine the risks arising from the existing dangers and dangers, to implement the risk control steps in detail, and to aim to raise the level of occupational health and safety by taking preventive measures (Ayanoğlu & Kurt, 2019). The most basic way to prevent occupational accidents, which have increased in recent years, is risk assessment. For this, risk assessment must be done very carefully and

meticulously. It should also be noted that the cost of preventing occupational accidents is much cheaper than the cost after an occupational accident.

Many manufacturing methods are used in production in the machinery and metal processing sector. One of the most used methods is the machining method, and milling machines have a very important place in machining. In the study, the existing hazards of universal and CNC controlled milling machines and the evaluation of the risks arising from these hazards were made with the Fine-Kinney method. As a result, the results were evaluated and preventive actions were clearly stated. In this way, it is aimed to prevent work accidents and occupational diseases that may occur.

2. Universal Milling Machine

Mills work by removing chips from the workpiece and shaping (drilling, surface treatment, hobbing, etc.) by means of a cutting tool that rotates around its axis (Güllü et al., 2006). On the other hand, milling is the process that occurs when the cutting movement rotates around itself and the connected part moves forward. Milling is divided into two as circumferential and face, in terms of machining method, that is, removal of sawdust. In circumferential milling, the chip is lifted by the teeth located at the periphery of the tool, while in face milling, the chip is lifted by the teeth on the face of the tool. Mills are also named horizontally and vertically according to the position of the spindle to which the tool is attached. In addition, there are universal milling machines that can work horizontally and vertically (Ünal, 2014).

In universal milling cutters, the bench table can be rotated to the left and right up to 45° with respect to the milling spindle. In this way, various helix channels allow machining in the desired direction with the help of manual or automatic feed. Milling machines basically consist of body, machine spindle, head, base, table, carriage and console parts. When universal cutters are additionally equipped with auxiliary parts such as divisor, tailstock, vertical and universal heads, and shaper heads, it becomes possible to mill all or some of the horizontal and vertical milling operations with all plane surfaces, various channels, holes, inclined surfaces. In addition to the safety measures to be taken, it is of great importance to know the dangers and risks of these parts very well. The parts of the universal milling machine are shown in Figure 1 below.

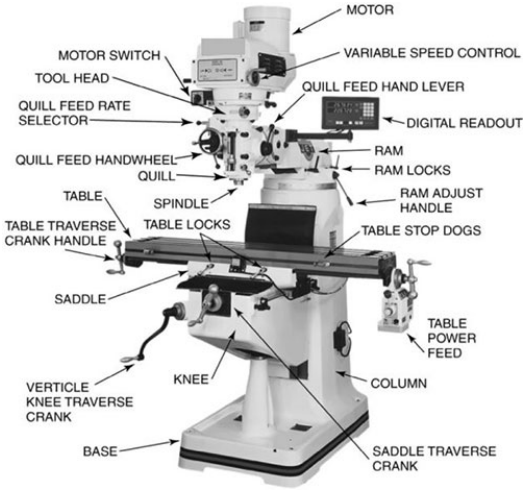

Figure 1. Parts of Universal Milling Machine (learnmechanical.com/milling-machine)

2.1. Hazards Found in Universal Milling Machines

One of the biggest dangers when dealing with the operations performed on milling machines is swarf or burrs throwing from the metal being processed. In order to prevent this risk, a transparent protector should be attached to the front of the workbench. In addition to being strong to prevent throwing metal swarf, this protector should be transparent, collapsible and height adjustable, which will not prevent the process from being seen.

It is extremely important to pay attention to the revolutions at which the workpieces should be processed on the milling machine. As a common situation, when an operation that should be performed at low speed is performed at high speed, there may be a danger of breaking the cutting edge and throwing parts around. In order to prevent this danger, a transparent that features described above protector should be used (Uğurlu, 2017; Bıyık, 2009).

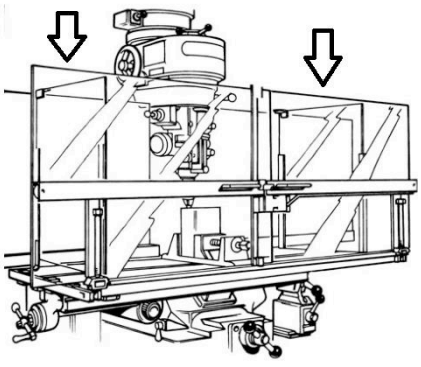

Figure 2. Using the Transparent Protector during Manufacturing with the Milling Machine (Uğurlu, 2014)

3. CNC Milling Machine

CNC milling machines, unlike universal milling machines, are computer-based, and the programmed processes are transmitted to the engine and mechanical parts of the machine with electronic signals, allowing the process to be carried out (Olam & Tosun, 2022). One of the biggest advantages of CNC machines is that it can be done faster and more smoothly during the production of finely detailed parts. Information such as the number of revolutions, the type of cutter and the steps to be used are programmed, ensuring that the operations are carried out both in a very short time and in a safe manner. In addition, the fact that the metalworking event takes place in a closed cabin is an extremely important issue in terms of occupational safety. The parts of the CNC milling machine are shown in Figure 3 below.

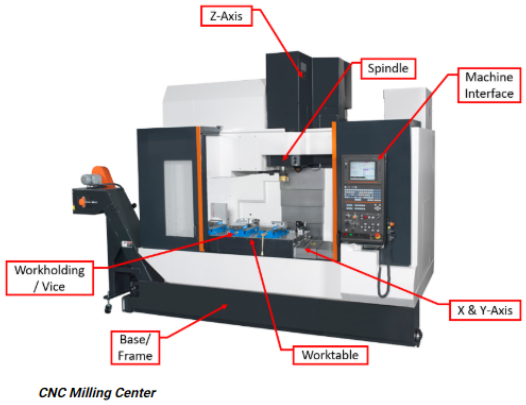

Figure 3. Parts of CNC Milling Machine (kiskiprecision.comservicesmachining-servicescnc-machining)

3.1. Hazards Found in CNC Milling Machines

As in other CNC machines, it is possible to enter the process information in CNC milling machines into a computer-based system, and therefore the process can be done without requiring the intervention of the employees. This is the most important factor showing that CNC machines are much safer than universal workbenches.

The biggest danger that can be encountered in CNC machines can be shown as interfering with the process by opening the cabinet door during the process. Therefore, in order to eliminate this danger, a switch system should be used to cut the energy of the system when the cabinet door is opened. Or there should be a lock system used in all other electrical devices that can be opened when the process is stopped or terminated (Uçum, 2020). Even if the devices are produced with all these precautions, it is possible for employees to disable these systems while performing reset and adjustment operations. For this reason, it can be said that a system design that stops working in cases where such interventions are carried out will be more beneficial for a safe working environment (Bağıran & Erçetin, 2022).

In addition, the ergonomic risks faced by those working in CNC milling machines are among the situations that should not be ignored. In both standing and sitting studies, the posture and movements of the employees have ergonomic risks (Rahman et al., 2014).

4. Milling Machines and Their Hazards

Milling and CNC controlled milling machines are the most basic machines in the manufacturing plants where machining is done. Considering its working principle, it is one of the machine tools that should be considered first in terms of occupational safety (Józwik & Pietras, 2013).

Therefore, increasing the reliability of machine tools and reducing the risks arising from the danger in the process is very important for the metalworking and manufacturing sector (Lo eat al., 2019).

4.1. Precautions to be Taken in Milling Machines

In general, there are some precautions to be taken due to the dangers of milling machines. These;

- Pulley, shaft and belt elements must be well protected.
- The blades must be covered with a fixed cover to prevent flying burrs and pieces.
- The coolant should be in the direction where the blades move away from the work.
- The workpiece must be securely mounted.
- Shaft and blade equipment should be mounted securely.
- Chips should be cleaned with the help of appropriate equipment when the machine is not working.
- Workers at the counter should not wear clothes such as ties, dangling clothes, gloves, long sleeved clothes while working.
- Employees should pay attention to cleaning rules in order to protect themselves from skin diseases that may arise from machine oils.
- Face shield or work goggles should be used to protect from metal burrs that may splash into the eyes.
- Measurement and calibration processes of the processed material should not be performed while the bench is running.
- Hand tools should not be left on the worktop (Ünal, 2014; Çeri, 2018).

Many of the above-mentioned precautions are the points to be considered while working on universal milling machines in terms of the danger they contain. Due to the nature of CNC milling machines, many of these hazards are either absent or greatly reduced.

5. Risk Assessment

One of the most important responsibilities brought to the employer by the Occupational Health and Safety Law No. 6331 on 30 June 2012 is risk assessment. It is expected that work accidents and occupational diseases will decrease with the risk assessment practices to be made. Although it is not sufficient to carry out a risk assessment alone, it is also necessary to meticulously follow up the measures and preventive actions to be taken (The Ministry of Labor and Social Security, 2012). The machinery equipment and metal products production sector discussed in the study contains many dangers, therefore hundreds of work accidents and occupational diseases occur in the sector every year. The most basic way to avoid this is a good risk assessment. The main purpose in the application of risk assessment should be to minimize the effects of existing hazards and risks, and to take the necessary measures before these potentially negative situations occur (Çakır, 2018).

5.1. Risk Assessment with Fine – Kinney Method

The Fine-Kinney method developed by Kinney and Wiruth is used to evaluate accident control mathematically (Oturakçı et al., 2015). With this method, after grading the risks, it is possible to find the jobs that need to be given priority and the transactions that need to be transferred to the current resources as a priority. For this, firstly, the rating is made by calculating the weight ratios of the risks, and then it is decided whether to take the measures or not. The Fine-Kinney method gives more realistic results as it provides the opportunity to use the statistics of the workplace (Erzurumluoğlu et al., 2015). This simple and convenient method is preferred and applied by small and medium-sized businesses (Gül et al., 2020).

Risk assessment with the Fine-Kinney method is calculated as;

$$R = P\ x\ F\ x\ S \quad (1)$$

Here; P = Probability, F = Frequency, S = Severity, R = is formed from the data, and the result gives the risk score (1). These values are given in tables 1, 2 and 3 (Erzurumluoğlu et al., 2015).

• Probability (probability): probability of damage occurring over time (between 0.1 and 10) It is shown in Table 1.

Table 1. Probability Values (Kinney and Wiruth, 1976).

Value	Probability (P)
10	Might well be expected
6	Quite possible
3	Unusual but possible
1	Only remotely possible
0.5	Conceivable but very unlikely
0.2	Practically impossible
0.1	Virtually impossible

• Frequency: Exposure to the same hazard repeatedly over time (between 0.5 and 10) It is shown in Table 2.

Table 2. Frequency Values (Kinney and Wiruth, 1976).

Value	Frequency (F)
10	Continuous
6	Frequent (daily)
3	Occasional (weekly)
2	Unusual (monthly)
1	Rare (a few per year)
0.5	Very rare (yearly)

• Severity: The harm that the hazard may cause to employees or the environment. It is shown in Table 3.

Table 3. Severity Degree (Kinney and Wiruth, 1976).

Value	Severity (S)
100	Catastrophe (many fatalities, or >$107 damage)
40	Disaster (few fatalities, or >$106 damage)
15	Very serious (fatality, or >$105 damage)
7	Serious (serious injury, or >$104 damage)
3	Important (disability, or >$103 damage)
1	Noticeable (minor first aid accident, or >$ 102 damage)

Preventive and corrective actions will be decided according to the risk level. These activities are violent and it does not affect the frequency, the only factor it will affect is probability. It is shown in Table 4.

Table 4. Risk value and Risk Assessment Result (Kinney and Wiruth, 1976).

Risk Value	Risk situation
400<R	Very high risk; consider discontinuing operation
200<R<400	High risk; immediate correction required (a few months)
70<R<200	Substantial risk; correction needed (within the year)
20<R<70	Possible risk; attention indicated (to be applied under supervision)
R<20	Risk; perhaps acceptable (precaution is not a priority)

First of all, probability, frequency and severity values of the identified risks are obtained in the tables. Then the risk score is calculated by multiplying these three values. Obtained risk scores are classified according to Table 4 and risk avoidance activities are planned according to risk priority order (Oturakçı et al., 2015). The necessary corrective actions or control measures are decided in order to reduce the risks that are very high to negligible level. In this step, which is one of the most important steps of risk assessment in practice, the measures to be taken to control risks and the methods to be used in determining these control measures are decided. While it is aimed to reduce the probability value of the damages that may occur with preventive measures, it is aimed to reduce the degree of severity with protective measures (Erzurumluoğlu et al., 2015).

6. Application: Risk Assessment in Universal Milling and CNC Milling Machines

In this section, some existing hazards given in Table 5 in universal and CNC milling machines used in the machine laboratory of a university were determined and risk assessment was made using the Fine-Kinney method and the results were evaluated.

Table 5. Hazards that may occur in milling machines

Number	Hazards that may occur in milling machines
1	Danger of any limb (hand, arm, etc.) being caught in rotating parts
2	Being electrocuted in situations where energy isolation is not good
3	Throwing hazard due to improper fixation of the part
4	Wearing rings, necklaces, dangling long-sleeved dresses or ties by staff working at the counter
5	Danger of wrapping in case of tampering with the rotating parts
6	The danger of exposure to noise while the machine is working and the consequent hearing loss and communication impairment
7	Manual handling of spiral swarf
8	Danger of not using swarf visor when necessary
9	Irritation on hands due to boron oil used for cooling and slippery floor danger due to leakage to the floor
10	Breaking of the cutting tip and throwing it around
11	Insufficient lighting
12	Insufficient coolant
13	Switch failure
14	Not ergonomic working conditions
15	Insufficient ventilation
16	Lifting and transporting heavy parts with non-ergonomic methods
17	Emergency stop button not working
18	Absence of machine guard
19	Not using protective glasses
20	Absence of warning signs
21	Lack of manuals, guidelines and safety instructions for operators

Under normal conditions, milling machines involve more dangerous situations when used in workshops. However, since the area where the benches discussed in the research are used is a university

laboratory, the existing hazards are limited to the hazards listed in Table 5.

When the universal milling machine in Figure 4 is examined, it is seen that there are many dangers for the workers. Considering these hazards, the risks that will arise are listed and a risk assessment is made according to the current situation and indicated in Appendix 1.

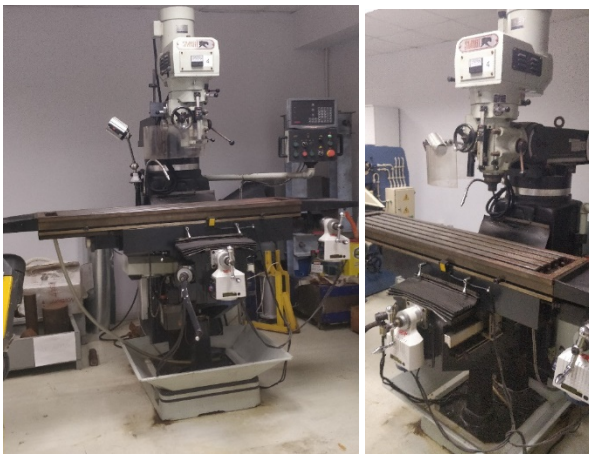

Figure 4. Universal milling machine

Many of the risks arising from the hazards given in Appendix 1 originate from the universal milling machine, and some of them are not found in the CNC milling machine. In the risk assessment, 9 of the 25 hazards originate only from the universal milling machine, and 12 of them originate from both universal and CNC milling machines. It has been determined that only 4 hazards are caused by CNC milling machines. The risk assessment made accordingly can be seen in Appendix 1.

Table 6. Risk Assessment Status Summary with the Fine-Kinney Method of Universal Mill

Acceptable Risk R<20	Possible Risk 20<R<70	Substantial Risk 70<R<200	High Risk 200<R<400	Very High Risk 400<R	Risk Average
2	0	5	8	6	302 High Risk

Looking at Appendix 1, it can be easily said that there are many risks as a result of the dangers in the universal milling machine, and that work accidents are inevitable if the necessary precautions are not taken. In the risk assessment made on the basis of the existing danger and the risks it contains, 2 acceptable risks, 5 substantial risks, 8 high risks and 6 unacceptable (very high) risks were determined, and measures to be taken in terms of eliminating or minimizing them were determined (Table 6). It is aimed to reduce almost all values to insignificant risk level as a result of the risk scores that emerge after the corrective/preventive actions to be taken.

Figure 5. CNC Milling Machine

Table 7. Risk Assessment Status Summary of CNC Milling with Fine-Kinney Method

Acceptable Risk R<20	Possible Risk 20<R<70	Substantial Risk 70<R<200	High Risk 200<R<400	Very High Risk 400<R	Risk Average
1	1	6	6	2	218,1 High Risk

The hazards and risks present in the CNC milling machine and the precautions to be taken are listed in Table 6. Looking at the table, 1 acceptable risk, 1 possible risk, 6 substantial risks, 6 high risks and 2 unacceptable risks were determined (Table 7).

7. Conclusion

With the risk assessment, it is seen that the dangers and risks in the universal milling machine are more than the CNC milling. It is a great advantage for the safety of both the worker and the other workers in the same environment that the work is carried out in a closed environment with computer aid in CNC machines. In the evaluation in Tables 6 and 7, it was determined that the average of 21 risks detected in the universal milling machine was higher than the average of 16 risks determined in the CNC milling machine. From this point of view, it is seen that the existing dangers and risks in the universal milling

machine are much more and open to work accidents compared to the CNC machine. When considered in general, it is foreseen that 6 unacceptable risks, 8 high risks, 8 substantial risks and 1 possible risk occurring in universal and CNC milling machines will be reduced to insignificant risk level by complying with the deadlines of necessary corrective/preventive actions. After the corrective/preventive actions to be carried out, the awareness of the employees to the existing dangers and risks in the milling machine will be increased and the dangers will be eliminated, a much safer production process will be created and the life safety of the employees will be ensured to a great extent. However, in order to prevent absent-mindedness and distraction that may compromise the safety of workers in their work as a result of factors such as fatigue, stress, noise, as well as their safety in proportion to the time spent at the milling machine, CNC-based systems are quite safe compared to universal systems. In addition to occupational safety, it is another important point that the labor and time spent on the work to be done can be reduced further with CNC systems. In this way, the production numbers and the spent labor will be used at an optimal level, and the production targets will be achieved in a shorter time and most importantly, in a safer way. When we look at the examples in the literature (Rachieru et al., 2015), many dangers of machine tools have been discussed in our study, and the machines that are the subject of the research have been examined by considering their use in the university laboratory. The existence of hazards and risks, which are also addressed in similar studies, actually shows the importance of vital risk assessment and subsequent regulatory and prior actions. It is possible to calculate the risk scores in these benches with the different risk assessment methods used in the studies and to guide on the studies to be done (Koçak, 2019; Pacana, 2017; Uçum, 2020). Following the risk assessments that should be carried out at regular intervals according to the hazard class, these regulatory and preventive activities should be carried out as soon as possible according to the severity of the hazards and risks. In this study, the risks encountered physically, chemically and ergonomically were discussed and it was aimed to increase the awareness of the employees by bringing detailed solution suggestions.

Conflict of Interest

There is nothing to declare as regards with conflict of interest.

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Appendix 1. Risk Evaluation of the Universal Mill with the Fine-Kinney Method

Risk Assessment by Fine-Kinney Method in Universal and CNC Milling Machines																	
Number	HAZARD IDENTIFICATION			RISK SCORE=PROBABILITYxFREQUENCYxSEVERITY					CORRECTIVE PREVENTIVE ACTION			TARGETED RISK AFTER PRECAUTION				
	Field of Activity of the Hazard	Hazard (Non-compliance)	Risk (Undesirable Effect)	Probability	Frequency	Severity	Risk Score	Risk Value	Corrective/Preventive Action to be Taken	Responsible	Deadline	Probability	Frequency	Severity	Risk Score	Risk Value
1	Universal Milling Machine	Metal swarf hitting the eye	Injury, damage to the eye	6	6	15	540	Very High RISK	A suitable shield should be made against metal swarf, so that the working worker should be protected from swarfs. A warning sign stating that it is forbidden to work without glasses and suitable work glasses should be hung on the milling machine, Effective control and inspection should be carried out and the worker working in the milling should be provided with glasses and workers should be trained on these issues.	Employer/Employer's Attorney	IMMEDIATELY	0,5	6	15	45	Possible Risk

2	Universal Milling Machine	Getting the work apron caught in the workbench	Serious injury of fingers and arms	3	2	40	240	**High RISK**	Employees should be trained about the use of the sleeves of the work aprons with elastic and non-hazardous use.	Employer/Employer's Attorney	within 1-2 months	0,5	2	40	40	Possible Risk
3	Universal Milling Machine	Milling chuck adjustment switch popping up	Serious injury or death to worker and bystanders	6	2	40	480	**Very High RISK**	Milling chuck protective equipment should be used. In addition, the Milling chuck adjustment key should never be left on the chuck, before starting to operate, it should be ensured that the part is firmly seated on the chuck.	Employer/Employer's Attorney	IMMEDIATELY	0,5	2	40	40	Possible Risk
4	Universal Milling Machine	Throwing of the workpiece	Serious injury or death to worker and bystanders	6	2	40	480	**Very High RISK**	There should be a guard in front of the bench. The parts processed on milling machines should be properly clamped or fixed with a vise so that they do not rotate with the tool. The protruding parts of the part connected to the turntables should be appropriately shielded.	Employer/Employer's Attorney	IMMEDIATELY	0,5	2	40	40	Possible Risk
5	Universal Milling Machine	Unprotected operation	Injury, loss of limb	10	6	15	900	**Very High RISK**	Machine guard facing the working environment should be used.	Employer/Employer's Attorney	IMMEDIATELY	0,5	6	15	45	Possible Risk

6	Universal Milling Machine	Slip/fall due to leakage of refrigerant to the floor	Injury due to slip/fall	3	2	3	18	Acceptable Risk	Before starting the process, the floor should be checked and cleaned.	Employer/Employer's Attorney	within a year	1	2	3	6	Acceptable Risk
7	Universal Milling Machine	Breaking of the cutting edge and throwing around	Serious injury to worker and bystanders	3	2	15	90	Substantial Risk	There should be a guard in front of the machine. Necessary inspections and observations should be made to ensure that the milling guard is permanently attached. Workers should be given the necessary occupational safety training not to remove the guards.	Employer/Employer's Attorney	within a year	0,5	2	15	15	Acceptable Risk
8	Universal Milling Machine	Wearing rings, necklaces, dangling long-sleeved dresses or ties by workers	Serious injury and/or death	3	2	40	240	**High RISK**	All jewelry should be removed before starting work. If there are clothes and ties, they should be removed and a suitable work apron with elasticated sleeves should be worn.	Employer/Employer's Attorney	within 1-2 months	0,5	2	40	40	Possible Risk
9	Universal Milling Machine	Non-ergonomic working conditions	Waist, musculoskeletal system ailments	6	10	3	180	Substantial Risk	The bench should be at elbow level for delicate work, hip level for light work, and lower for heavy work. The floor must be non-slip. Bench length by worker should be adjusted, if necessary, a footrest should be placed.	Employer/Employer's Attorney	within a year	1	10	3	30	Possible Risk

10	Universal Milling Machine/CNC Milling Machine	Noise	Hearing loss	3	6	7	126	Substantial Risk	Noise measurement should be done. If the noise is above 80 decibels, ear protection should be available, and if it is above 85 decibels, the employees should use ear protection.	Employer/Employer's Attorney	within a year	1	6	7	42	Possible Risk
11	Universal Milling Machine/CNC Milling Machine	Electrically powered machinery and body of equipment's lack of grounding	Death by electrocution	3	6	40	720	**Very High RISK**	The body of the machines is grounding and mounted in a visible way will be. Periodically, grounding control and measurement will be carried out.	Employer/Employer's Attorney	IMMEDIATELY	0,5	6	40	120	Acceptable Risk
12	Universal Milling Machine/CNC Milling Machine	Emergency stop button not working	In an emergency death as a result of failure to stop the machine	6	1	40	240	**High RISK**	Periodic checks of the emergency stop button on the operator's part of the machine will be done.	Employer/Employer's Attorney	within 1-2 months	1	1	40	40	Possible Risk
13	Universal Milling Machine/CNC Milling Machine	Manual handling of spiral swarf	Injury of hands and fingers	6	6	7	252	**High RISK**	While the part is being processed, the swarf in the cutting tool mouth should not be cleaned. The swarf that come out should not be swept by hand, suitable work gloves	Employer/Employer's Attorney	within 1-2 months	0,2	6	7	8,4	Acceptable Risk

									and brushes should be used for this work.							
14	Universal Milling Machine/CNC Milling Machine	Manual handling of parts during operation	Injury of hands and fingers	6	3	15	270	**High RISK**	While the milling machine is running, tools that remove swarf, couplings and machined parts should not be disassembled, adjusted or loosened. Transparent or grid type protective covers that must be kept closed while the milling is operating should be fitted and this cover should not be removed or canceled by the workers. Necessary warning signs should be posted and workers should be trained on the subject.	Employer/Employer's Attorney	within 1-2 months	1	3	15	45	Possible Risk
15	Universal Milling Machine/CNC Milling Machine	Irritation of various parts of the body due to splashes of coolant	Deformation in the skin	6	6	7	252	**High RISK**	Shields should be made against splashing of the coolant. Also, gloves should be used.	Employer/Employer's Attorney	within 1-2 months	0,2	6	7	8,4	Acceptable RISK

16	Universal Milling Machine/CNC Milling Machine	The work area of the operator working at the bench is narrow	Fall, minor injury	0,5	6	3	9	Acceptable RISK	There should be enough space for the personnel to move freely.	Employer/Employer's Attorney	within a year	0,2	6	3	3,6	Acceptable Risk
17	Universal Milling Machine/CNC Milling Machine	The operator leaves the machine open when leaving the machine	Limb impingement/ amputation/ loss	3	3	15	135	Substantial Risk	The operator should not leave the workbench during the process, and should stop the process when it is necessary to leave.	Employer/Employer's Attorney	within a year	0,5	3	15	22,5	Possible Risk
18	Universal Milling Machine/CNC Milling Machine	Lighting	Vision loss due to insufficient lighting	6	6	15	540	**Very High RISK**	Sufficient artificial lighting will be provided in areas and hours where daylight is not sufficient.	Employer/Employer's Attorney	IMMEDIATELY	0,5	6	15	45	Possible Risk
19	Universal Milling Machine/CNC Milling Machine	Heavy item removal	Waist, musculoskeletal system ailments	3	6	7	126	Substantial Risk	Mechanical vehicles will be used as much as possible in removing, and ergonomics training will be given on lifting heavy parts.	Employer/Employer's Attorney	within a year	1	6	7	42	Possible Risk

20	Universal Milling Machine/CNC Milling Machine	Lack of warning signs	Dangerous work due to forgetting the conditions that must be observed before and during the work	6	6	7	252	**High RISK**	Before starting the machine and during operation, warning signs indicating the rules to be followed and the protective equipment to be used should be placed in appropriate places and necessary training should be given to those who will work on the bench.	Employer/Employer's Attorney	within 1-2 months	3	1	7	21	Possible Risk
21	Universal Milling Machine/CNC Milling Machine	Lack of manuals for workers, safety instructions and working methods	Dangerous work due to the inability to ensure the correct and safe use of machines	6	6	7	252	**High RISK**	It should be ensured that machine user manuals and guides are prepared for those who will work on the machine. Safety instructions should be posted in the relevant places. Necessary training programs should be organized on the safe use of machines accompanied by guides and guides.	Employer/Employer's Attorney	within 1-2 months	1	2	7	14	Acceptable Risk
22	CNC Milling Machine	Burning of the hands while taking the material in case of insufficient cooling during the operation	Burns on hands	2	2	7	28	Possible Risk	It is necessary to control the operation of the engine that controls the coolant, and to carry out periodic maintenance without interruption. In addition, it should be ensured that suitable work gloves are used.	Employer/Employer's Attorney	within a year	0,5	2	7	7	Acceptable Risk

23	CNC Milling Machine	Switch failure	Injury, damage to the eyes	3	2	15	90	Substantial Risk	In cases where the switch is not closed with the capacitive sensor application, the system is not allowed to operate.	Employer/Employer's Attorney	within a year	0,5	2	15	15	Acceptable Risk
24	CNC Milling Machine	Non-ergonomic working conditions	Eye strain, waist and back pain	6	6	3	108	Substantial Risk	Workers who will work in vehicles with screens should be trained on eye protection, the screen should be adjusted to a vertical position, the distance between the screen and the eyes should be at least 60 cm. There should be a suitable space in front of the keyboard where the staff can lean their arms, the back should be straight and lean, the head should be upright, the calves should be fully seated on the chair. Desk screen, keyboard, documents etc. It should be wide enough to comfortably hold the materials. Keyboard and mouse can be used in natural position with supported hand/wrist.	Employer/Employer's Attorney	within a year	1	6	3	18	Acceptable Risk

25	CNC Milling Machine	Insufficient ventilation	Air pollution in the working environment, flaming/explosion hazard	3	2	15	90	Substantial Risk	According to the type of part processed in CNC milling machines, the vapors of the oils used spread to the environment. Oil vapors emitted to the environment must be removed by filter and ventilation systems, as they contain safety risks such as explosion, flaming, etc., both for human health and safety.	Employer/Employer's Attorney	within a year	0,5	2	15	15	Acceptable Risk