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A “framework” – “pilot application” and practical manual for the management of competences in metal enterprises

Development of a "framework" – "pilot application" and practical manual for the management of competences in metal enterprises

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O1. Competence Management Methodology and Pilot Application

Introduction

The intellectual output, O1 of SMART - COMET project consists of developing a learning outcome – based competence management framework for metal industry. The development of this framework has been done based on the analysis of various competence management tools and methodologies from project countries; Turkey, Germany, Spain and other EU country practices; Italy and the UK has also been worked on and have been beneficial in the comparison. A coherent, adaptable and practical enterprise level competence management system, covering ECVET tools and learning outcomes is the result of this work.

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Analysing existing competence management models with the use of desk research and interviews with enterprise representatives; the project experts concluded that there are three main steps of a concrete competence management model:

1. Identify critical competencies
2. Measure and evaluate competencies
3. Determine knowledge gaps and give feedback
4. Create development plans

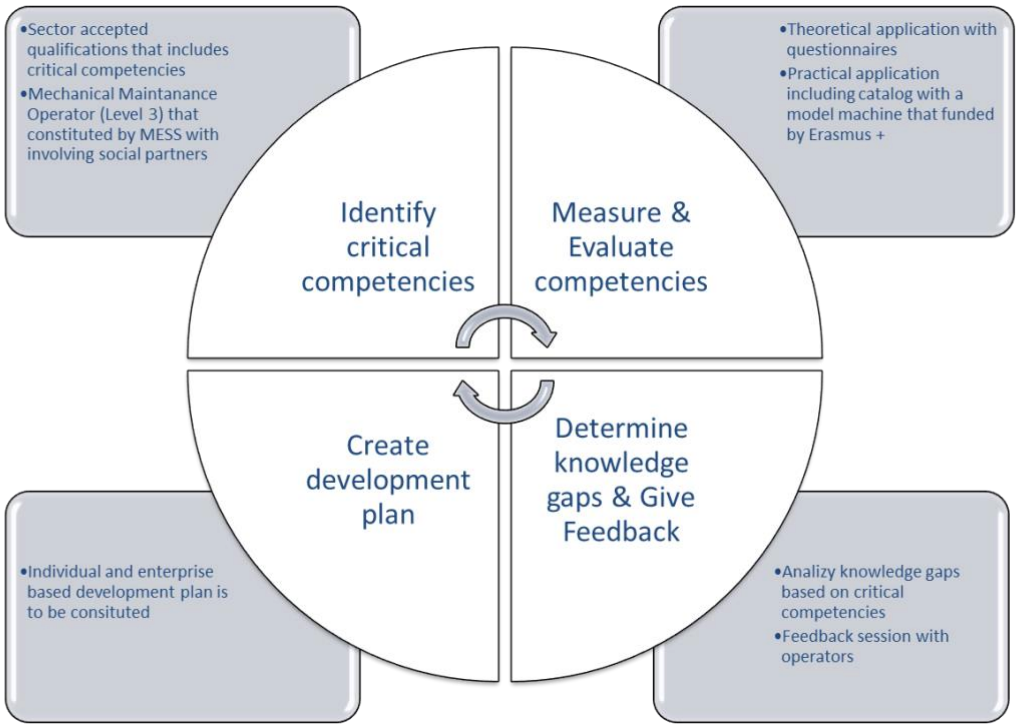


Figure 1. Competence Management Framework

The initial step starts with analysing already **identified critical competencies** determined by Vocational Qualifications Authority[1] (VQA) of Turkey. It uses national occupational standards and national qualifications in certifying the employees in order to prove that they are capable of doing this certain work. To be able to get the certificate, the employees' know-how, attitude and capabilities are evaluated by accredited trainers and institutions. MESS is one of these accredited institutions. The national occupational standards and occupational qualifications are defined and drafted with participation and feedback from different stakeholders; VET schools, enterprises, NGOs and other relevant public institutions. These standards and qualifications are recognised by the whole industry and are also referred both nationally, internationally and at the supranational; EU level, serving as a base coming from European Qualifications Framework (EQF).

26 occupational standards developed so far by MESS using VQA standards and qualifications in metal sector were then individually analysed. **Mechanical Maintenance Operator Level 3** was chosen to be examined in this study, because it has a key role in the industry and yet it is not easy to find a high - qualified machine maintenance operator in the sector. This position

[1] For detailed information on Vocational Qualifications Authority (MYK) of Turkey, please refer to *page 9*.

will also have a critical role in Industry 4.0 transition period, and analysing member enterprises operating in metal sector, it is possible to say that almost all member companies have at least a couple of Machine Maintenance Operators in their production. This means all of them need qualified machine maintenance operators, so there is a serious gap between the number needed by the industry and the already existing number of workers. The project team, together with project partners decided that understanding knowledge gaps of the machine maintenance employees in different enterprises and then coming up with a comprehensive competence management model will be beneficial for the whole industry.

The following step is to **measure and evaluate competencies** chosen. For this, a pilot application is created and done in 4 MESS member enterprises. The results are also exploited in **determining knowledge gaps and giving feedback**.

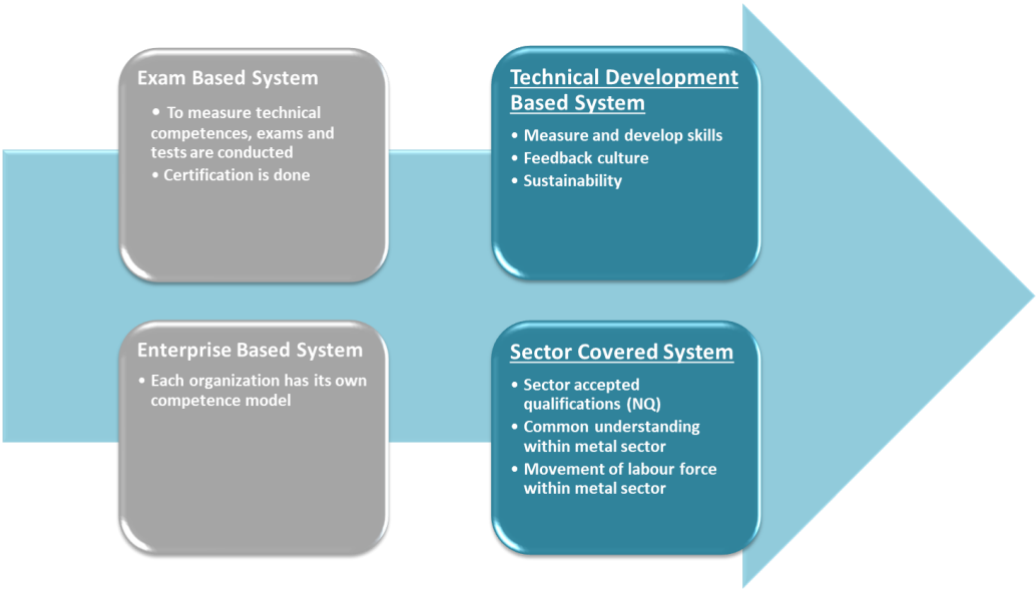


Figure 2. Changing mindset

In the mainstream exam based system, VQA accredited institutions are using examination method and providing a certificate if the candidate counts qualified. It is important to note that the employees are taking this exam unless they are graduate of vocational and technical schools (VET) and the certificate is valid for 5 years. Each enterprise also has their own customised competence model, so the project team offered a technical development based system and a development plan analysing the results from different companies and a development based competence management model is also being created basing on the application done in 4 different enterprises; Ford, Arçelik, TürkTraktör and İçdaş. In this way, the result was a coherent sector based system that is disseminated to the metal sector as a whole. This system also contributes to the free movement of labour force within the metal sector and creates a common understanding about development of technical competencies through skill needs.

This pilot application is done in two stages; theoretical and practical stages. The theoretical part of the application was composed of three parts;

- A1: Occupational Health and Safety, Environment and Quality
- B1: Preventive Maintenance
- B2: Corrective Maintenance

Theoretical part was then followed by an on-the-job pilot application with the help of the prototype machine and equipment designed for the project. Participants applied what they apply on the field using the prototype machine.

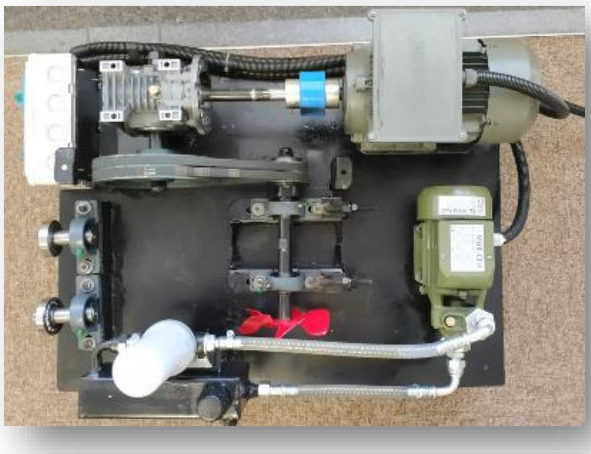


Figure 3. Prototype Machine

The last step of competence management model is **creating development plans**. Following pilot exercises in 4 different enterprises, project research and development team will create

a development plan in order to increase capability of Mechanical Maintenance Operator Level 3 competencies in Turkey[2]. The evaluations of expert technician and researchers form a basis for this report. According to the capabilities which are open for improvement, technical trainings will be developed which are offered by the research team. The development plan will have a key role regarding competency model which will be designed at the end of the process.

1. Pillars of Vocational Qualifications

1.1. European Qualifications Framework

European Qualifications Framework (EQF) is a European-wide qualifications framework which brings the qualifications of different European countries together. In a way, it is a translation of different national qualifications which makes qualifications in different countries easier to understand. The EQF aims to facilitate mobility of students and workers within Europe in order to encourage development of mobile and flexible workforce and to help developing lifelong learning (Cedefop, 2018).

EQF opens up the ability for employers, individuals and institutions to better understand the qualifications of employers, learners in other countries and serves as a benchmark for comparing the qualifications systems of countries.

EQF was formally adopted by the European Parliament and the Council in April 2008. EQF Advisory Group is consisted of 28 EU member countries; candidate 5 countries, 3 non-EU-member European Economic Area member countries; a total of 36 countries (Myk.gov.tr, 2018).
EQF Advisory Group is consisted of European Commission, Council of Europe, Europe Vocational Training Development Center (CEDEFOP), European Education Foundation (ETF), European level roof representatives of institutions, social partners and stakeholders.

The EQF enables learners, learning providers and employers to compare qualifications between different national systems. This is thought to help increase mobility in the labor

[2] Please refer to the last part of this manual for development plan.

market within and between the countries because it makes it easy to determine a person's level of qualification which in turn will improve the balance between demand and supply of knowledge and skills. This framework comprises general, higher and vocational education and training, and should lead to better transparency, comparability and portability of citizens' qualifications (e.g. diplomas, certificates etc.) (Eqavet.eu, 2018).

The EQF recommends that each level of qualification should, in principle, be attainable by way of a variety of educational and career paths. This should foster lifelong learning and increase the employability, mobility and social integration of workers and learners. The recommendation should also facilitate building bridges between formal, non-formal and informal learning.

The EQF neither replaces nor defines national qualification systems. It does not describe any particular qualifications or individual competencies but describes the eight EQF levels via descriptors for the three categories "knowledge", "skills" and "competencies".
States are encouraged to develop national qualifications frameworks that rely on and are linked to the EQF.

1.2. National Qualifications Framework

Countries develop **national qualifications frameworks** (NQFs) in order to implement the EQF. Frameworks help to make qualifications easier to understand and compare. They can also encourage countries to rethink and reform national policy and practice on education, training and lifelong learning.

National qualifications frameworks (NQFs) classify qualifications by level, based on learning outcomes. This classification reflects the content and profile of qualifications that is, what the holder of a certificate or diploma is expected to know, understand and be able to do. The learning outcomes approach also ensures that education and training sub-systems are open to one another. Thus, it allows people to move more easily between education and training institutions and sectors.

All countries committed to the EQF are developing or implementing national frameworks mostly covering all levels and types of qualifications: the 28 Member States, Iceland, Liechtenstein, Norway, Switzerland, Albania, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Montenegro, Serbia and Turkey.

1.2.1. Vocational Qualifications Authority (VQA) of Turkey

Vocational Qualifications Authority (VQA) was established on September 21, 2006. Establishment of sector committees, creation of business environment with workers, employers and other professional organizations, publication of national occupational standards to Official Gazette, establishment of assessment and certification infrastructure and authorization of certification bodies have all started to be presented as of 2008, as the main activities of the organization.

Significant developments have been made in the European Union (EU) to improve the quality and mobility of the labor force when VQA started its activities. The "European Qualifications Framework for Lifelong Learning (EQF)" issued by the European Parliament and Council has been issued. In this decision, it is recommended that EU member and EU candidate countries establish national competence frameworks to link national qualifications with EQF levels and take all necessary measures to ensure that all qualifications documents have a reference to EQF levels.

In Turkey, VQA has been designated as the EQF National Coordination Point and in 2008 it started to represent Turkey in the EQF Advisory Board. In this context, VQA has undertaken an important task in Turkey Qualifications Framework (TQF) creation and referencing it using EQF (Myk.gov.tr, 2018).

1.2.2. Turkish Qualifications Framework (TQF)

Turkey Qualifications Framework (TQF); designed to be compatible with the European Qualifications Framework; refers to the framework of national qualifications that demonstrate all the qualification principles gained in vocational, general and academic education and training programs, including primary, secondary and higher education, and other learning pathways.

'Qualification' under the TQF represents Certificate, Mastery Certificate or VQA Professional Qualification Certificate obtained in the event that the responsible institution acquires an evaluation and validation period in which the individual acquires learning achievements in accordance with certain criteria.

2. National Standards and National Qualifications

2.1. Definition of National Occupational Standards

National Occupational Standard is a minimum norm in terms of required know-how, capability, attitude and approach in order to perform an occupation with success. These national standards of occupations are determined by industry and educational institutions considering their requirements.

Vocational Qualifications Authority is authorizing the institutions and organizations that operate in the sector in which the certain National Occupational Standard is decided to be created, providing that these institutions and organizations meet the certain necessities.

National Occupational Standard (NOS) is prepared in accordance with the format of approved occupational standard, which is prepared by examining the international examples in terms of form, content and gathering opinion from the sector committee. The proficiency levels of National Occupational Standards are determined in accordance with the qualification levels adopted by European Union and European Qualification Framework (EQF).

Thus, the National Occupational Standards are prepared and in the process of preparation all carry the following basic principles:

- It is based on job analysis.
- Effective participation of the relevant social partners in the preparation process is essential.
- It reflects the professional competence levels.
- It includes health, safety and environmental protection requirements related to the occupational field.
- It is written clearly and explicitly.
- It is compatible with lifelong learning principles.
- It does not include the discrimination of any kind.

Standards to be prepared are determined by Executive Board of the VQA, taking into account priority needs of job market and educational institutions and recommendations of the sector committees.

2.1.1. Steps of Preparing a Standard

In order to recognize the draft occupational standards prepared by VQA approved institutions or the working groups established by the VQA within the framework of the relevant legislation as National Occupational Standard, the applicant must firstly issue the "Occupation Map" for the relevant sector (Myk.gov.tr, 2018).

While extracting occupational maps related to the sector, the main sections (sub-sectors) of the sector are classified into groups and the occupations, boundaries and levels of each group are determined.

The purpose of occupational map is to make a general analysis of the industry, thus providing a general picture of sub-sectors, occupations, employee numbers, key trends in the sector, employment characteristics and priorities. Draft occupational standards, comments and evaluation forms and other related documents are examined by the relevant sector committee of VQA. The draft occupational standards examined by the sector committee are presented to the VQA Executive Board.

National Occupational Standards approved by the Executive Board are published in the Official Gazette and gain the National Occupational Standard. For reassessment of National Occupational Standards that have been going on for five years since its publication in the Official Gazette, the institutions and organizations that have developed the standard are called up first and the relevant standard is updated if necessary.

2.1.3. Content of a National Occupational Standard

- **Introduction of Occupation:**

Introduction of Occupation: The statements which determines borders of occupation and includes briefly duties of occupation.

Place of Occupation in International Classification Systems: In this section, ISCO-08 code in coding system (International Occupation Standard Classification) is indicated.

Health, Security and Environmental Arrangements: In this section, precautions in terms of OHS and environmental protection are defined alphabetically.

Other Legislations Regarding Occupation: It can be stated as required legislations of occupation. In this context, borders of occupation, duties in the scope of occupation and legislation regarding capabilities of employee are stated alphabetically. Defined legislations must be related to occupation.

Work Environment and Provisions: The conditions of occupation are evaluated. In this context, work environment in terms spatial features such as lighting, noise, climate, individual or team work facilities and risk of occupational accidents are defined.

Other Requirements Related to Occupation: In this section, the documents, certificate and state of health which the employee requires are defined.

- **The Profile of Occupation**

Duty: General term which defines basics of occupation. It should be individually meaningful.

Operations: Unit of work which has measurable and observable factors. Start and finish time intervals must be determined.

Performance Index: The capability to profess is evaluated objectively in terms of national and international accepted standards. Performance index focuses on “how?” instead of “what?”.

Required Equipment: The equipment which are used in order to profess the occupation. Employee must have technical know-how using tools.

Information and Capabilities: In this section, information and capabilities which an employee require are alphabetically defined. It should include duties and operations related to required performance index

Attitude and Behaviors: In this sections attitudes and behaviors which should be practicing by employee are alphabetically defined. These attitudes and behaviors should be parallel to work environment and occupation.

2.2. Definition of National Qualifications

2.2.1. Preparing National Qualifications

National Qualifications are prepared based upon national and international occupational standards. National Qualifications are constituted in order to illustrate the process how to assess related competences and know-how. The documents are authorized by Vocational Qualifications Authority.

Assessments are made by instructions which is authorized by vocational qualifications authority. If an individual succeeds these assessments, deserves to get a certificate. This certificate certifies this individual is capable to do certain occupation.

Qualification unit; is mandatory or selective qualifications section which is stated in national qualifications. It is transferrable and it is measured objectively.

Learning outcome; Information, know-how, capability after completing any learning process (formal or non-formal training).

National Qualifications are prepared by institutions which are authorized by Vocational Qualifications Authority or study group which is created by them.

National qualifications which are prepared by instructions are investigated in terms of methodology and are presented to interested parties in order to get their comments. During preparing these drafts the comments are getting into consideration and if they are accepted, these comments become a part of qualifications. After completing interpretation process, intuition that prepared national qualifications a pilot assessment and controls its applicability and measurability. Sector committee examines reasons of updates and presents to submit to the approval of Vocational Qualifications Authority Board. National Qualifications approved by board are published on web-site of Vocational Qualifications Authority and goes into operation.

After completing updating process, intuition informs licensing organization (assessor) regarding final outcome. In case, there are respectable number of updates, licensing organization updates documentation and licensing processes.

3. Methodology and Approach to Pilot Application

3.1. Introduction to the Methodology and Approach to Pilot Application

Mechanical Maintenance Operators in enterprises are generally composed of people graduated from VET schools and /or in some instance gained experiences from a master in workshop conditions without having any vocational training.

Operators who got experiences in the workshop, without having an academic knowledge and technical background, has contributed to working life with the help of the maintenance person in the direction of the knowledge and experience gained in the current working environment. Knowledge and skills gained by these workers need to be recorded and documented professionally.

Therefore, "National Occupational Standards" was initiated by the government, following the European Qualifications Framework standards. VQA (Vocational Qualifications Authority) was established, and it works with Metal Sector Committee to examine and approve the occupational standard called the National Qualification of Mechanical Maintenance Operator (Level 3).

“Regulation on the Preparation of National Vocational Standards and National Qualifications" has been taken into consideration as the basic criteria in the preparation of this qualification.

3.1.1. Basic Criteria for National Qualifications

- National Qualification of Mechanical Maintenance Operator (Level 3) is based on national vocational standards and / or international standards".
- National competence has been prepared with a participatory approach and the opinions and contributions of related stakeholders have been taken.
- National competence covers occupational health and safety, environment and quality aspects.
- National competence is written to be understood by users.
- National competence encourages self-development and career advancement within the framework of long-life learning principles.
- National competence does not include any discriminatory elements, open or confidentiality.
- National competence includes elements which are ensuring that the individual's knowledge, skills and competence are measured within quality assurance.

3.2. Scope of Work

National Qualification of Mechanical Maintenance Operator (Level 3) is selected to be worked on for this study. Detailed information may be found at:
http://www.smart-comet.eu/wp-content/uploads/2018/08/National-Qualification.pdf

3.3. National Qualification Structure

Structure of a national qualification is divided into "Compulsory Units" and "Elective Units"

Compulsory Units

A1: Occupational Health and Safety, Environment and Quality

Elective Units

B1: Preventive Maintenance

B2: Corrective Maintenance

Participants is expected to complete compulsory units of group A and at least one of elective units in group B in order to be considered as successful. This means; A1, B1 or A1, B2 or the option of A1, B1 and B2 may also be chosen.

Theoretical and performance based applications in the units may be done separately for each unit or together at the same time. However, evaluation of each unit is performed independently.

4. Pilot Application

The pilot application consisted of a focus group discussion with the employees of the factory whose vocational qualifications were observed, it was followed by a both theoretical and practical application on the qualification.

For these two parts, following documents have been created by the project team:

- Machine Catalogue (Turkish and English)
- Theoretical Application Booklet (Turkish and English)

4.1. A1 - Occupational Health and Safety, Environment and Quality Unit

Theoretical Application

Theoretical application with equal points each and a minimum of 20 written applications are given to participants.

No points are deducted from incorrect applications.

Participants are given 1.5 minutes for each application.

A participant who completes at least 60% of the applications in written application is considered qualified.

The following items were taken into consideration while preparing the theoretical applications;

- Occupational health and safety
- Environmental protection measures
- Quality requirements

In addition, for a total number of 20 theoretical applications related to this merit is taken as reference Appendix A1-2 list of relevant National Competency catalogue. It includes all the expressions mentioned below and proposed to be measured.

BG1. Explains basic rules on occupational health and safety.

BG2. Explains personal protective equipment suitability for work and workshop.

BG3. Describes the functions of protection and intervention of OHS.

BG4. Describes how to install warning signs and plates with locking and labelling systems for the workshop.

BG5. Explains warning signs and plates for work done.

BG6. Explains how to contribute in identifying of risks at the work.

BG7. Describes the reduction of risk factors.

BG8. Explains machine-specific emergency procedures.

BG9. Describes exit or escape procedures in emergency situations.

BG10. Explains what the environmental risks are.

BG11. Describes how the environmental risks will be reduced.

BG12. Describes the storage period of recycled materials.

BG13. Sorts the processes of saving money in consumption of business resources.

BG14. Explains what quality requirements are involved in maintenance jobs.

BG15. Explains quality assurance techniques in maintenance work.

BG16. Explains the faults and errors that are detected during the operation.

4.2. B1 – Preventive Maintenance Unit

Theoretical Application

Theoretical application with equal points each and a minimum of 25 written applications are given to participants.

No points are deducted from incorrect in the applications.

Participants are given 1.5 minutes for each application.

A participant who completes at least 60% of the applications is considered successful.

The following items were taken into consideration while preparing the theoretical applications;

- Machine, hardware and material preparations
- Preventive maintenance activities

In addition, for a total number of 25 theoretical applications related to this merit is taken as reference Appendix B1-2 list of relevant National Competency catalogue. It includes all the expressions mentioned below and proposed to be measured.

BG1. Explain the eligibility criteria for OHS for materials, tools and materials.

BG2. Defines the negativities that affect the safety of work in the environment where the machines placed.

BG3. Lists any negativity that should be controlled such as sound, temperature, smell and pollution.

BG4. Explain the eligibility criteria for OHS in working environment.

BG5. Explains the basic working principles and technology of the machine.

BG6. Explains the basic features of spare parts and consumables of the machines.

BG7. Lists the consumables required for maintenance work.

BG8. Lists of the apparatus, tools and equipment required for operation.

BG9. Lists the measurement and control instruments to be used in the process.

BG10. Explains the control steps of the work equipment and safety mechanisms.

BG11. The sequence of operations to be performed on the connections of electricity, water, compressed air, steam and gas installations before maintenance activities.

BG12. Sorts the parts of the machine that need to be lubricated.

BG13. Explains oil types and usage areas.

BG14. Sequences the parts and connections that may be able to loosen in the machines.

BG15. Explains the cleaning procedures involved in preventive maintenance activities.

BG16. Sorts the cleaning materials in preventive maintenance activities.

BG17. Explains the procedures for oil change.

BG18. Sorts usage areas and types of filters, seals, sealants, bearings and belts.

BG19. Sorts the consumables for limited shelf life.

BG20. Sequences the setting operations to be done in the changed parts.

BG21. Explains the simple setting operations performed on the machines.

BG22. Explains maintenance information to be given to the machine operator.

BG23. Describes the relevant maintenance information to be given to the appropriate supervisor.

BG24. Explains maintenance procedures to be processed on control cards.

Performance Based Application

In the B1 unit for performance based application, "Skills and Competencies" are carried out according to the checklist defined below. Participants must achieve a minimum of 80% to qualify in the overall performance, provided that they perform all of the critical steps to prove to be sufficient enough in the performance application.

Performance based applications are carried out in a real or fictitious work environment.

In addition, for performance based application related to this merit is taken as reference Appendix B1-2 list of relevant National Competency catalogue. It includes all the expressions mentioned below and proposed to be measured.

BY1. Examines basic operating principles of machines.

BY2. Examines machine's catalogues, recognizes machine elements from technical drawings.

BY3. Prepares consumables in accordance with the work to be done.

BY4. Makes ready necessary apparatus, machinery and equipment for operation.

BY5. Prepare measurement and control instruments according to the specified process.

BY6. Controls the operation of the safety mechanisms of the machine to be maintained in accordance with the instructions.

BY7. Takes necessary safety precautions about the machine.

BY8. Closes or controls all power supply connections that may be associated with the machine or workspace to be maintained.

*BY9. The machines must be lubricated in accordance with the operating instructions or maintenance instructions.

BY10. Performs the tightening process by checking possible loose parts and connections.

*BY11. Cleans the machine from foreign substances such as oil, dust, rust, metal fragments.

*BY12. Makes the oil change of the machines.

BY13. Makes necessary measurements using micrometre, calliper and appropriate measuring instruments.

*BY14. Changes the filter.

*BY15. Replaces sealing element.

*BY16. Replaces V-belt.

*BY17. Replaces bearing

BY18. Adjusts the parts that need to be changing and setting allows them to work in the desired way.

BY19. Starts the machine and make the final checks.

*BY20. Records performed operations on maintenance control cards.

*BY21. Implements the OSH rules in the works.

*BY22. Implements environmental protection measures in the works.

*BY23. Conducts quality requirements in the works.

(*)Mandatory critical steps to be accomplished in the performance applications.

4.3. B2 – Corrective Maintenance Unit

Theoretical Application

Theoretical application with equal points each and a minimum of 20 applications are given to participants.

No points are deducted from incorrect applications.

Participates are given 1.5 minutes for each application.

A participant who completes at least 60% of the applications is considered successful.

The following items were taken into consideration while preparing the theoretical application questions;

- Machine, hardware and parts preparation
- Simple faults handling
- Post-maintenance finishing
- OHS, environmental and quality requirements

In addition, for a total number of 20 theoretical application related to this merit is taken as reference Appendix B2-2 list of relevant national qualifications catalogue. It includes all the expressions mentioned below and proposed to be measured.

BG1. Explain the eligibility criteria for OHS for materials, tools and materials.

BG2. Defines the negativities that affect the safety of work in the environment where the machines placed.

BG3. Lists any negativity that should be controlled such as sound, temperature, smell and pollution.

BG4. Describes safety criteria for working environment.

BG5. Explains the basic working principles and technology of the machine.

BG6. Explains the basic features of spare parts and consumables of the machines.

BG7. Lists the consumables required for maintenance work.

BG8. Lists of the apparatus, tools and equipment required for operation.

BG9. Lists the measurement and control instruments to be used in the process.

BG10. Explains the control steps of the work equipment and safety mechanisms

BG11. The sequence of operations to be performed on the connections of electricity, water, compressed air, steam and gas installations before maintenance activities.

BG12. Sorts types of sealing elements.

BG13. Explains the mechanical components of the machines.

BG14. Sorts the spare parts to be used in the elimination of mechanical failures.

BG15. Explains maintenance information to be given to the machine operator.

BG16. Describes the relevant maintenance information to be given to the appropriate supervisor.

BG17. Explains maintenance procedures to be processed on control cards.

Performance Based Application

In the B2 unit for performance-based application, "Skills and Competencies" are carried out according to the checklist defined below. Candidates must achieve a minimum of 80% to qualify in the overall performance, provided that they successfully perform all of the critical steps to ensure success in the performance application.

Performance-based applications are carried out in a real or fictitious work environment.

In addition, for performance-based application related to this merit is taken as reference Appendix B2-2 list of relevant National Competency catalogue. It includes all the expressions mentioned below and proposed to be measured.

BY1. Examines basic operating principles of machines.

BY2. Examines machine's catalogues, recognizes machine elements from technical drawings.

BY3. Prepares consumables in accordance with the work to be done.

BY4. Makes ready necessary apparatus, machinery and equipment for operation.

BY5. Prepares measurement and control instruments according to the specified process.

BY6. Controls the operation of the safety mechanisms of the machine to be maintained in accordance with the instructions.

BY7. Takes necessary safety precautions about the machine.

BY8. Closes or controls all power supply connections that may be associated with the machine or workspace to be maintained.

*BY9. Resolves the fault caused by the sealing element.

BY10. Makes necessary measurements using micrometre, calliper and appropriate measuring instruments.

*BY11. Takes precautions to ensure the safety of the work environment, such as keeping foreign / dangerous items away.

BY12. Adjusts the parts that need to be changing and setting allows them to work in the desired way.

*BY13. Parts that need to be disassembled in order to reach the disruptive parts should be disassembled according to instructions and manuals.

*BY14. Replaces new parts according to instructions or manuals.

*BY15. Repairs defects caused by mechanical parts.

*BY16. Starts the machine and make the final checks.

BY17. Records performed operations on maintenance control cards.

*BY18. Implements the OHS rules in the works.

*BY19. Implements environmental protection measures in the works.

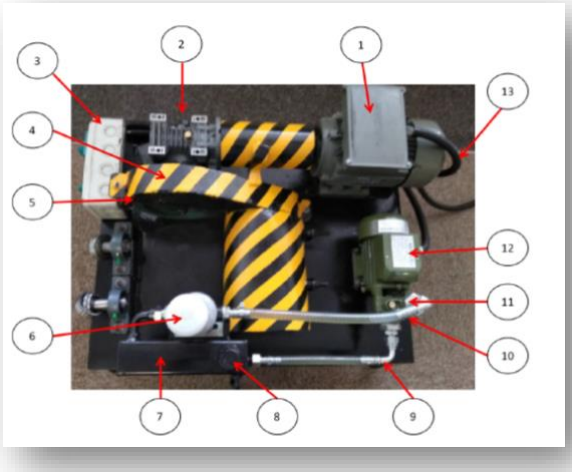
*BY20. Conducts quality requirements in the works.

(*)Mandatory critical steps to be accomplished in the performance applications.

4.4. Prototype Machine

A prototype machine is designed for this pilot application, shown below to implement all the performances defined in "Skills and Competences".

Although this prototype machine is designed for the pilot application, it is lightweight and portable, so it offers an advantage for real application where all performances may be performed on this machine.



1. Electric Motor
2. Reduction Gearbox
3. Control Panel
4. Top Protection Cover
5. Belt and Pulley Assembly
6. Oil Filter
7. Oil Tank
8. Oil Filler Cap and Strainer
9. Oil Return Line
10. Oil Feeding Line
11. Oil Pump
12. Electric Motor
13. Power Supply Line

Figure 4. Prototype Machine and its components

4.5. Evaluation Approach

The results of the application and the evaluation of the candidates are defined in the National Qualification of “10UY0002-3 Mechanical Maintenance Operator (Level 3)”.

For the theoretical applications, the correct responses marked by the participant in the application guide are summed up and divided by the total number of applications to obtain the percentage of success (%).

- Difficulty ratings of questions in theoretical practice; (1= Easy), (2 = Medium) ve (3 = Difficult)

A1 - Occupational Health and Safety, Environment and Quality Unit (Theoretical Application);

- Difficulty level 1 = 9 applications (% 45)
- Difficulty level 2 = 8 applications (% 40)
- Difficulty level 3 = 3 applications (% 15)

B1 - Preventative Maintenance Unit (Theoretical Application);

- Difficulty level 1 = 11 applications (% 44)
- Difficulty level 2 = 9 applications (% 36)
- Difficulty level 3 = 6 applications (% 24)

B2 - Corrective Maintenance Unit (Theoretical Application);

- Difficulty level 1 = 5 applications (% 25)
- Difficulty level 2 = 9 applications (% 45)
- Difficulty level 3 = 6 applications (% 30)

In the performance based application; a "Work Order" is given. The participant completes the preparatory work with the work order given to him. Reads through machine instructions, prepares replacement spare parts within periodic control card and keep present consumables. The examiner evaluates the technical methods and approaches used by the candidate and the criteria such as hand skill, quickness, point of view to quality approach, checking at the end of the work and recording the work done.

4.5.1. Evaluation Method and Applications Set

The content applications may be found in the Appendix.

Candidates in Theoretical Applications;

"A1 Occupational Health and Safety, Environment and Quality Qualification Unit" is a compulsory application that the candidates who succeed at least 60% of the total 20 applications.

"B1 Preventive Maintenance Qualification Unit" is a selective application that the candidates who succeed at least 60% of the total 25 applications.

"B2 Corrective Maintenance Qualification Unit" is a selective application that the candidates who succeed at least 60% of the total 20 applications.

Candidates in Performance Applications;

The performance-based application for B1 unit is carried out according to **"Skills and Competencies"**. The participant must demonstrate at least 80% success in the overall application, provided that all critical steps are successfully performed to ensure success in the B1 performance application.

The performance-based application for B2 unit is carried out according to **"Skills and Competencies"**. The participant must demonstrate at least 80% success in the overall application, provided that all critical steps are successfully performed to ensure success in the B2 performance application.

4.5.2. Personal Application in Target Enterprises

Dates of applications are pre-planned within the target enterprises to be performed and the application will be done as seen in the following chart.

The trial participants are two persons from each unit and there will be a total of 8 people in four enterprises.

Date of Performance	Target Enterprise	Theoretical Application	Performance Application
01.08.2018	Ford Otosan / Gölcük	10;00 – 11;40	13;00 – 14;30
			14;40 – 16;00
03.08.2018	İçdaş /Biga	10;00 – 11;40	13;00 – 14;20
			14;30 – 15;40
10.08.2018	TürkTraktör / Ankara	09;15 – 10;55	11;00 – 12;30
			13;30 – 15;00
14.08.2018	Arçelik / Çayırova	09;00 – 10;40	11;00 – 13;10
			13;15 – 14;45

4.5.3. Evaluation and Observations

A1 - Occupational Health and Safety, Environment and Quality Unit Assessment and Surveillance Data

Qst. No	No	Expression Information	Ford OTOSAN		İÇDAŞ		TÜRK TRAKTÖR		ARÇELİK		Note	Evaluation
			Tech. 1	Tech. 2	Tech. 3	Tech. 4	Tech. 5	Tech. 6	Tech. 7	Tech. 8		
1	BG1	Explains basic rules on occupational health and safety	D	D	D	D	D	D	Y	D	14/16	%88
2			D	D	D	D	D	D	Y	D		
3	BG2	Explains personal protective equipment suitability for work and workshop	D	D	D	D	D	D	D	D	8/8	%100
4	BG3	Describes the functions of protection and intervention of OHS	D	D	Y	D	D	D	D	D	7/8	%88
5	BG4	Describes how to install warning signs and plates with locking and labelling systems for the workshop	D	Y	Y	Y	Y	Y	D	Y	8/16	%50
6			D	D	D	Y	D	Y	D	D		
7	BG5	Explains warning signs and plates for work done.	D	D	D	D	D	D	D	D	8/8	%100
8	BG6	Explains how to contribute in identifying of risks at the work..	D	D	D	D	D	D	D	Y	7/8	%88

9	BG7	Describes the reduction of risk factors	D	D	D	D	D	Y	Y	D	6/8	%75
10	BG8	Explains machine-specific emergency procedures	D	D	D	Y	D	D	D	D	7/8	%88
11	BG9	Describes exit or escape procedures in emergency situations	D	D	Y	D	D	Y	D	D	6/8	%75
12	BG10	Explains what are the environmental risks	D	Y	D	D	Y	Y	Y	D	12/16	%75
13			D	D	D	D	D	D	D	D		
14	BG11	Describes how the environmental risks will be reduced.	D	D	D	D	D	D	D	D	8/8	%100
15	BG12	Describes the storage period of recycled materials	Y	Y	Y	Y	Y	Y	Y	Y	0/8	%00
16	BG13	Sorts the processes of saving money in consumption of business resources.	Y	D	D	D	D	D	D	D	7/8	%88
17	BG14	Explains what quality requirements are involved in maintenance jobs	D	D	D	Y	D	D	Y	D	6/8	%75
18	BG15	Explains quality assurance techniques in maintenance work	D	D	D	D	D	D	D	D	14/16	%88
19			D	D	D	D	Y	Y	D	D		
20	BG16	Explains the faults and errors that are detected during the operation	Y	Y	Y	Y	Y	Y	Y	Y	0/8	%00
RESULTS			85	80	75	70	75	60	65	80		%74

B1 Preventive Maintenance Unit - Assessment and Surveillance Data

Qst. No	No	Expression Information	Ford OTOSAN		İÇDAŞ		TÜRK TRAKTÖR		ARÇELİK		Note	Evaluation
			Tech. 1	Tech. 2	Tech. 3	Tech. 4	Tech. 5	Tech. 6	Tech. 7	Tech. 8		
1	BG1	Explain the eligibility criteria for OHS for materials, tools and materials	Y	Y	D	Y	Y	Y	D	Y	2/8	%25
2	BG2	Defines the negativities that affect the safety of work in the environment where the machines placed.	D	D	D	D	D	D	D	Y	7/8	%88
3	BG3	Lists any negativity that should be controlled such as sound, temperature, smell and pollution	D	D	Y	Y	D	D	Y	D	6/8	%75
4	BG4	Explain the eligibility criteria for OHS in working environment	D	D	D	D	D	D	D	D	8/8	%100
5	BG5	Explains the basic working principles and technology of the machine.	Y	D	D	D	D	Y	Y	D	10/16	%63
6			D	D	Y	Y	D	D	D	Y		
7	BG6	Explains the basic features of spare parts and consumables of the machines	D	D	Y	D	D	D	D	D	7/8	%88
8	BG7	Lists the consumables required for maintenance work	D	Y	Y	Y	Y	Y	Y	Y	1/8	%13
9	BG8	Lists of the apparatus, tools and equipment required for operation	D	D	D	D	D	D	D	D	8/8	%100
10	BG9	Lists the measurement and control instruments to be used in the process.	D	Y	D	D	D	D	D	Y	6/8	%75
11	BG10	Explains the control steps of the work equipment and safety mechanisms	D	D	D	D	D	D	D	D	8/8	%100
12	BG11	The sequence of operations to be performed on the connections of electricity, water, compressed air, steam and gas installations before maintenance activities	Y	D	D	D	D	D	D	Y	6/8	%75
13	BG12	Sorts the parts of the machine that need to be lubricated.	D	D	D	D	D	Y	D	D	7/8	%88
14	BG13	Explains oil types and usage areas	Y	Y	D	Y	D	D	Y	D	4/8	%50
15	BG14	Sequences the parts and connections that may be	D	D	D	D	D	D	D	D	8/8	%100

		able to loosen in the machines										
16	**BG15**	Explains the cleaning procedures involved in preventive maintenance activities.	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**Y**	**7/8**	**%88**
17	**BG16**	Sorts the cleaning materials in preventive maintenance activities	**D**	**Y**	**D**	**Y**	**D**	**Y**	**Y**	**Y**	**3/8**	**%38**
18	**BG17**	Explains the procedures for oil change	**Y**	**Y**	**D**	**Y**	**Y**	**D**	**Y**	**D**	**3/8**	**%38**
19	**BG18**	Sorts usage areas and types of filters, seals, sealants, bearings and belts.	**Y**	**Y**	**D**	**Y**	**D**	**Y**	**D**	**Y**	**3/8**	**%38**
20	**BG19**	Sorts the consumables for limited shelf life.	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**8/8**	**%100**
21	**BG20**	Sequences the setting operations to be done in the changed parts.	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**8/8**	**%100**
22	**BG21**	Explains the simple setting operations performed on the machines	**D**	**D**	**D**	**D**	**Y**	**Y**	**Y**	**D**	**5/8**	**%63**
23	**BG22**	Explains maintenance information to be given to the machine operator	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**8/8**	**%100**
24	**BG23**	Describes the relevant maintenance information to be given to the appropriate supervisor.	**D**	**D**	**D**	**D**	**D**	**D**	**Y**	**D**	**7/8**	**%88**
25	**BG24**	Explains maintenance procedures to be processed on control cards.	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**8/8**	**%100**
RESULTS			**76**	**72**	**84**	**68**	**84**	**72**	**68**	**64**		**%74**

B2 Corrective Maintenance Unit - Assessment and Surveillance Data

Qst. No	No	Expression Information	Ford OTOSAN		İÇDAŞ		TÜRK TRAKTÖR		ARÇELİK		Note	Evaluation
			Tech. 1	Tech. 2	Tech. 3	Tech. 4	Tech. 5	Tech. 6	Tech. 7	Tech. 8		
1	BG1	Explain the eligibility criteria for OHS for materials, tools and materials	D	D	D	D	D	D	D	D	8/8	%100
2	BG2	Defines the negativities that affect the safety of work in the environment where the machines placed	D	D	D	D	D	D	D	D	8/8	%100
3	BG3	Lists any negativity that should be controlled such as sound, temperature, smell and pollution	Y	Y	D	Y	Y	Y	Y	D	2/8	%25
4	BG4	Describes safety criteria for working environment	D	D	D	D	D	D	D	D	8/8	%100
5	BG5	Explains the basic working principles and technology of the machine	D	D	D	Y	D	D	Y	D	6/8	%75
6	BG6	Explains the basic features of spare parts and consumables of the machines	D	D	D	D	D	Y	Y	D	13/16	%81
7			D	D	D	D	D	D	Y	D		
8	BG7	Lists the consumables required for maintenance work	D	D	D	D	D	D	Y	Y	6/8	%75
9	BG8	Lists of the apparatus, tools and equipment required for operation.	D	D	D	D	D	D	D	D	8/8	%100
10	BG9	Lists the measurement and control instruments to be used in the process.	Y	D	Y	Y	D	Y	D	Y	3/8	%38
11	BG10	Explains the control steps of the work equipment and safety mechanisms	D	D	D	Y	Y	Y	D	Y	4/8	%50
12	BG11	The sequence of operations to be performed on the connections of electricity, water, compressed air, steam and gas installations before maintenance activities	D	D	D	Y	Y	Y	Y	D	4/8	%50
13	BG12	Sorts types of sealing elements	D	Y	Y	D	Y	Y	Y	Y	2/8	%25
14	BG13	Explains the mechanical components of the machines.	D	Y	Y	D	Y	Y	Y	Y	2/8	%25
15	BG14	Sorts the spare parts to be used in the elimination of mechanical failures	D	D	D	D	D	D	D	D	13/16	%81
16			D	Y	Y	D	D	D	D	Y		

17	BG15	Explains maintenance information to be given to the machine operator	D	D	D	D	D	D	D	D	8/8	%100
18	BG16	Describes the relevant maintenance information to be given to the appropriate supervisor	D	Y	Y	D	D	D	D	Y	5/8	%63
19	BG17	Explains maintenance procedures to be processed on control cards	D	D	D	D	D	D	D	D	13/16	%81
20			D	D	Y	D	Y	D	Y	D		
RESULTS			90	75	70	75	70	65	55	65		%71

B1 – Performance Based Application - Assessment and Surveillance Data

Qst. No	No	Expression Information	Ford OTOSAN		İÇDAŞ		TÜRK TRAKTÖR		ARÇELİK		Note	Evaluation
			Tech 1	Tech 2	Tech 3	Tech. 4	Tech. 5	Tech. 6	Tech. 7	Tech. 8		
1	BY1	Examines basic operating principles of machines	3	3	3	3	3	3	3	3	3	(24 / 24) %100
2	BY2	Examines machine's catalogues, recognizes machine elements from technical drawings	3	3	3	3	3	3	3	3	3	(24 / 24) %100
3	BY3	Prepares consumables in accordance with the work to be done.	3	3	3	3	3	3	3	3	3	(24 / 24) %100
4	BY4	Makes ready necessary apparatus, machinery and equipment for operation.	3	4	3	4	4	4	4	4	4	(30 / 32) %94
5	BY5	Prepare measurement and control instruments according to the specified process.	-	-	2	3	4	4	-	-	4	(13 / 32) %40
6	BY6	Controls the operation of the safety mechanisms of the machine to be maintained in accordance with the instructions.	4	3	3	4	4	4	3	4	4	(29 / 32) %90
7	BY7	Takes necessary safety precautions about the machine	4	3	3	4	4	4	3	4	4	(29 / 32) %90
8	BY8	Closes or controls all power supply connections that may be associated with the machine or workspace to be maintained	5	5	5	5	-	5	5	5	5	(35 / 40) %88
9	BY9	The machines must be lubricated in accordance with the operating instructions or maintenance instructions	4	4	5	4	5	5	5	4	5	(36 / 40) %90
10	BY10	Performs the tightening process by checking possible loose parts and connections.	4	3	5	4	4	5	5	5	5	(35 / 40) %88
11	BY11	Cleans the machine from foreign substances such as oil, dust, rust, metal fragments	5	4	4	4	5	5	5	4	5	(36 / 40) %90

12	**BY12**	Makes the oil change of the machines	**5**	**5**	**5**	**4**	**5**	**5**	**5**	**5**	**5**	(39 / 40) **%98**
13	**BY13**	Makes necessary measurements using micrometre, calliper and appropriate measuring instruments.	**-**	**-**	**3**	**4**	**4**	**3**	**-**	**-**	**5**	(14 / 40) **%35**
14	**BY14**	Changes the filter	**5**	**5**	**3**	**5**	**4**	**5**	**5**	**5**	**5**	(37 / 40) **%93**
15	**BY15**	Replaces sealing element	**5**	**5**	**4**	**5**	**4**	**5**	**5**	**5**	**5**	(38 / 40) **%95**
16	**BY16**	Replaces V-belt.	**5**	**5**	**3**	**5**	**4**	**5**	**4**	**3**	**5**	(34 / 40) **%85**
17	**BY17**	Replaces bearing	**4**	**4**	**4**	**5**	**5**	**5**	**4**	**3**	**5**	(34 / 40) **%85**
18	**BY18**	Adjusts the parts that need to be changing and setting allows them to work in the desired way.	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	(22 / 24) **%92**
19	**BY19**	Starts the machine and make the final checks.	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	(22 / 24) **%92**
20	**BY20**	Records performed operations on maintenance control cards	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**3**	**4**	(31 / 32) **%97**
21	**BY21**	Implements the OHS rules in the works.	**4**	**4**	**3**	**4**	**3**	**4**	**4**	**3**	**4**	(29 / 32) **%90**
22	**BY22**	Implements environmental protection measures in the works	**4**	**3**	**4**	**4**	**3**	**4**	**3**	**4**	**4**	(29 / 32) **%90**
23	**BY23**	Conducts quality requirements in the works	**4**	**4**	**3**	**4**	**4**	**4**	**3**	**3**	**4**	(29 / 32) **%90**
24	**BY24**	Leaves the work place well organized	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	(23 / 24) **%96**
RESULTS			**87**	**83**	**82**	**94**	**88**	**98**	**82**	**82**	**100**	**% 87**

B2 – Performance Based Application - Assessment and Surveillance Data

Qst. No	No	Expression Information	FORD OTOSAN		İÇDAŞ		TÜRK TRAKTÖR		ARÇELİK		Note	Evaluation
			Tech. 1	Tech. 2	Tech. 3	Tech. 4	Tech. 5	Tech. 6	Tech. 7	Tech. 8		
1	BY1	Examines basic operating principles of machines.	3	3	3	3	3	3	3	3	3	(24 / 24) %100
2	BY2	Examines machine's catalogues, recognizes machine elements from technical drawings	3	3	3	3	3	3	3	3	3	(24 / 24) %100
3	BY3	Prepares consumables in accordance with the work to be done	3	3	3	3	3	3	3	3	3	(24 / 24) %100
4	BY4	Makes ready necessary apparatus, machinery and equipment for operation	3	4	4	4	4	4	4	4	4	(31 / 32) %97
5	BY5	Prepare measurement and control instruments according to the specified process.	-	-	2	4	4	4	-	-	4	(14 / 32) %44
6	BY6	Controls the operation of the safety mechanisms of the machine to be maintained in accordance with the instructions	4	4	3	4	4	4	4	4	4	(31 / 32) %97
7	BY7	Takes necessary safety precautions about the machine	4	4	3	4	4	4	4	4	4	(31 / 32) %97
8	BY8	Closes or controls all power supply connections that may be associated with the machine or workspace to be maintained.	5	5	5	5	5	5	5	5	5	(40 / 40) %100
9	BY9	Resolves the fault caused by the sealing element.	8	8	7	9	8	8	7	7	10	(62 / 80) %78
10	BY10	Makes necessary measurements using micrometre, calliper and appropriate measuring instruments.	5	3	3	5	4	3	-	3	5	(26 / 40) %65
11	BY11	Takes precautions to ensure the safety of the work environment, such as keeping foreign / dangerous items away.	4	4	4	5	5	4	4	3	5	(32 / 40) %80
12	BY12	Adjusts the parts that need to be changing and setting allows them to work in the desired way.	4	4	4	5	5	5	5	4	5	(36 / 40) %90
13	BY13	Parts that need to be disassembled in order to	4	4	4	5	5	4	5	4	5	(35 / 40) %88

		reach the disruptive parts should be disassembled according to instructions and manuals										
14	**BY14**	Replaces new parts according to instructions or manuals	**8**	**8**	**7**	**8**	**8**	**8**	**8**	**7**	**10**	(62 / 80) **%78**
15	**BY15**	Repairs defects caused by mechanical parts	**4**	**5**	**4**	**5**	**5**	**4**	**5**	**4**	**5**	(36 / 40) **%90**
16	**BY16**	Starts the machine and make the final checks.	**4**	**4**	**5**	**5**	**5**	**5**	**4**	**5**	**5**	(37 / 40) **%93**
17	**BY17**	Records performed operations on maintenance control cards.	**3**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	(31 / 32) **%97**
18	**BY18**	Implements the OHS rules in the works	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	(32 / 32) **%100**
19	**BY19**	Implements environmental protection measures in the works	**4**	**4**	**3**	**3**	**3**	**4**	**4**	**4**	**4**	(29 / 32) **%90**
20	**BY20**	Conducts quality requirements in the works	**4**	**4**	**3**	**3**	**3**	**4**	**3**	**4**	**4**	(28 / 32) **%88**
21	**BY21**	Leaves the work place well organized	**3**	**4**	**3**	**3**	**3**	**4**	**3**	**4**	**4**	(27 / 32) **%84**
RESULTS			**84**	**86**	**81**	**94**	**92**	**91**	**82**	**83**	**100**	**%87**

Observations

Each of the evaluation and surveillance data obtained from the theoretical and performance applications made within the framework of the qualification units are considered separately and evaluated as follows.
In both applications;

- Performing basic training for the subjects between 0 and 60 points
- Performing an improvement study for the subjects between 61 and 80 points
- For the subjects between 81 and 100 points evaluated, it was concluded as SUFFICIENT.

A1 - Observations on the THEORETICAL application in the Occupational Health and Safety, Environment and Quality Unit;

⇨ BG4 - In the application "5 and 6" about "Describes how to install warning signs and plates with locking and labelling systems for the workshop", candidates completed 8 out of 16 applications. So the performance was %50.

⇨ BG12 - In the application "15" about "Describes the storage period of recycled materials", candidates could not give any correct response. So the performance was %0.

⇨ BG16 - In the application "20" about "Explains the faults and errors that are detected during the operation", candidates could not give any correct response. So the performance was %0.

⇨ **A1 - Occupational Health and Safety, Environment and Quality unit is averaged 74% for the THEORETICAL application.**

B1 - Observations on the THEORETICAL application in the Preventive Maintenance Unit;

⇨ BG1 - In the application "1" about *"Explain the eligibility criteria for OHS for materials, tools and materials"*, candidates completed 2 out of 8 applications. So the performance was %25.

⇨ BG5 - In the application "5 and 6" about *"Explains the basic working principles and technology of the machine"*, candidates completed 10 out of 16 applications. So the performance was %63.

⇨ BG7 - In the application "8" about "Lists the consumables required for maintenance work", candidates completed 1 out of 8 applications. So the performance was %13.

⇨ BG13 - In the application "14" about *"Explains oil types and usage areas",* candidates completed 4 out of 8 applications. So the performance was %50.

⇨ BG16 - In the application "17" about *"Sorts the cleaning materials in preventive maintenance activities"*, candidates completed 3 out of 8 application. So the performance was %38.

⇨ BG17 - In the application "18" about *"Explains the procedures for oil change"*, candidates completed 3 out of 8 applications. So the performance was %38.

⇨ BG18 - In the application "19" about *"Sorts usage areas and types of filters, seals, sealants, bearings and belts",* candidates completed 3 out of 8 applications. So the performance was %38

⇨ BG21 - In the application "22" *about "Explains the simple setting operations performed on the machines"*, candidates completed 5 out of 8 applications. So the performance was %63.

⇨ **B1 - Preventive Maintenance Unit is averaged 74% for the THEORETICAL application.**

B2 - Observations on the THEORETICAL application in the Corrective Maintenance Unit;

⇨ BG3 - In the application "3" about *"Lists any negativity that should be controlled such as sound, temperature, smell and pollution"*, candidates completed 2 out of 8 applications. So the performance was %25.

⇨ BG9 - In the application "10" about *"Lists the measurement and control instruments to be used in the process"*, candidates completed 4 out of 8 applications. So the performance was %50.

⇨ BG10 - In the application "11" about *"Explains the control steps of the work equipment and safety mechanisms"*, candidates completed 3 out of 8 applications. So the performance was %38.

⇨ BG11 - In the application "12" about *"The sequence of operations to be performed on the connections of electricity, water, compressed air, steam and gas installations before maintenance activities"*, candidates completed 4 out of 8 applications. So the performance was %50.

⇨ BG12 - In the application "13" about *"Sorts types of sealing elements",* candidates completed 2 out of 8 applications. So the performance was %25.

⇨ BG13 - In the application "14" about *"Explains the mechanical components of the machines"*, candidates completed 2 out of 8 applications. So the performance was %25.

⇨ BG16 - In the application "18" about *"Describes the relevant maintenance information to be given to the appropriate supervisor"*, candidates completed 5 out of 8 application. So the performance was %63.

⇨ **B2 - Corrective Maintenance Unit is averaged 74% for the THEORETICAL application.**

B1 - Observations on the PERFORMANCE application in the Preventive Maintenance Unit;

⇨ BY5 - Candidates scored 13 points on a total of 32 points for *"Prepare measurement and control instruments according to the specified process"*. So the performance was %40.

⇨ BY13 - Candidates scored 14 points on a total of 40 points for *"Makes necessary measurements using micrometre calliper and appropriate measuring instruments"*. So the performance was %35.

⇨ **B1 - Preventive Maintenance Competence Unit is averaged 87% for the PERFORMANCE application.**

B2 – Observations on the PERFORMANCE application in the Corrective Maintenance Competence Unit;

⇨ BY5 - Candidates scored 14 points on a total of 32 points for *"Prepare measurement and control instruments according to the specified process".* So the performance was %44.

⇨ BY9 - Candidates scored 62 points on a total of 80 points for *"Resolves the fault caused by the sealing element"*. So the performance was %78.

- ⇨ BY10 - Candidates scored 26 points on a total of 40 points for *"Makes necessary measurements using micrometre calliper and appropriate measuring instruments"*. So the performance was %65.
- ⇨ BY14 - Candidates scored 62 points on a total of 80 points for *"Replaces new parts according to instructions or manuals"*. So the performance was %78.
- ⇨ **B2 - Corrective Maintenance Unit is averaged 87% for the PERFORMANCE application.**

5. Recommendations

5.1. Improvement Areas

Improvement areas were identified according to the competence units in the evaluation data obtained from the observations.

Theoretical Application;

- ❖ **A1 - Occupational health and Safety:** There was no sufficient information and experience about the Visual and Guidance Signs used in Occupational Health and Safety,
- ❖ **A1 - Environment:** There was no sufficient information and experience about the Visual and Guidance Signs used in environment,
- ❖ **A1 - Quality:** The statements regarding Preventive maintenance, Corrective maintenance and Improvement maintenance work being applied for maintenance were not clearly understood,
- ❖ **B1 - Preventive Maintenance / Environment:** The lack of environmental awareness of the disposal of consumable materials were used during maintenance,
- ❖ **B1 - Preventive Maintenance / Principle of Basic Machine Work:** Work done before the detailed preliminary inspection of the machines is studied,
- ❖ **B1 - Preventive Maintenance / Consumables:** The permanent parts of the machine and the consumables used for maintenance were not clearly understood,
- ❖ **B1 - Preventive Maintenance / Oils:** The appropriate use of oil in the machines could not be selected properly,
- ❖ **B1 - Preventive Maintenance / Cleaning Materials:** The cleaning materials used during the maintenance of the machines were not clearly understood,
- ❖ **B1 - Preventive Maintenance / Machine Parts:** It was not clearly understood what the mechanical parts of the machine are functioning,
- ❖ **B1 - Preventive Maintenance / Basic Settings:** No simple presets were performed,
- ❖ **B2 - Corrective Maintenance / Technical Terms:** It was not understood what is the meaning of technical terms for the machines used for,
- ❖ **B2 - Corrective Maintenance / Measuring Tools:** Candidates do not have enough knowledge about measuring tools/instruments,

- **B2 - Corrective Maintenance / Control Steps:** When removing and installing a machine part, they did not follow the order of the process,
- **B2 - Corrective Maintenance / Technical Drawing:** Candidates were not friendly to technical drawing and circuit symbols,
- **B2 - Corrective Maintenance / Procedures:** Any of procedure was not followed after maintenance and repair work.

Performance Based Application;

- **B1 - Preventive Maintenance / Measuring and Control Tools:** During the preventive maintenance, no measurement and control tools were prepared.
- **B1 - Preventive Maintenance / Measuring and Control Tools:** During the preventive maintenance application, the measurements were made visually to be determined without the need for measuring tools.
- **B2 - Corrective Maintenance / Measuring and Control Tools:** During the corrective maintenance, no measurement and control tools were prepared
- **B2 - Corrective Maintenance / Sealing Elements:** Precisely selection of spares, dismantling and fitting of the sealing elements need to be paid attention. No care and attention was shown when working on sealing elements during application.
- **B2 - Corrective Maintenance / Measuring and Control Tools:** During the corrective maintenance application, the measurements were made visually to be determined without the need for measuring tools
- **B2 - Corrective Maintenance / Part Replacement:** Selection and replacement of new parts must be done according to the manual and / or machine catalogue. No reference was used for the part replacement application.

Briefly summarizing the improvement areas;

- Participants had difficulties in recognition of the existing visual and directory signs in their shopfloor.
- Statements regarding the purpose and types of machine maintenance; preventive, corrective and improvement maintenance were not clearly understood by the participants.
- The lack of environmental awareness in terms of the use and disposition of consumable materials has been observed.
- Participants began to implement work orders without understanding the parts and principles of the pilot machine and examining the technical drawings in the Machine Catalogue that are designed to guide them through the process.
- There is a lack of knowledge on the oils used in the machines and the intended use of oil.
- Participants had troubles with the use of measuring tools and did not follow proper procedures according to control steps when removing and installing parts.
- Even though participants were quite successful to implement work orders, they had difficulties to document the work on a previously prepared template and they needed support.

Proto-type Machine Development Process for Performance Applications

Mechanical Maintenance Operator – Level 3

Prototype machine was designed to assess Mechanical Maintenance Operator's technical competence and this on the job assessment is used in certification process.

On the prototype machine circuits, respectively circuit A and circuit B.

Circuit A;

Electrical energy is to be transformed mechanical energy via electric motor. Energy is transmitted through interconnection coupler to reductor gear and through belt mechanism to blower fan from different angles. Fan was designed to cool oil radiator which stands in front of it.

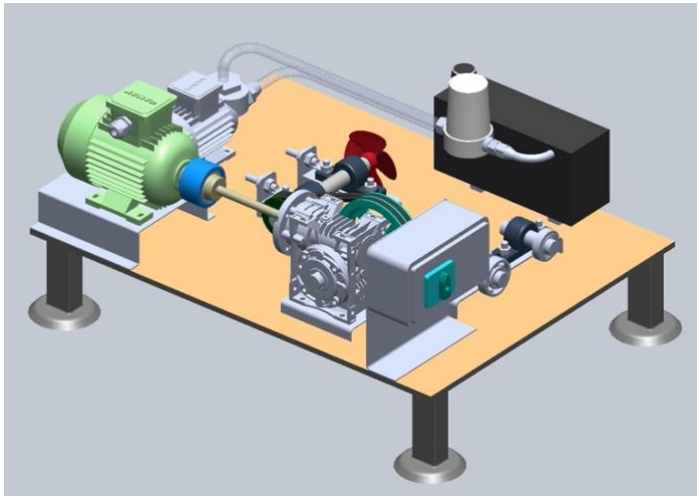
Circuit B;

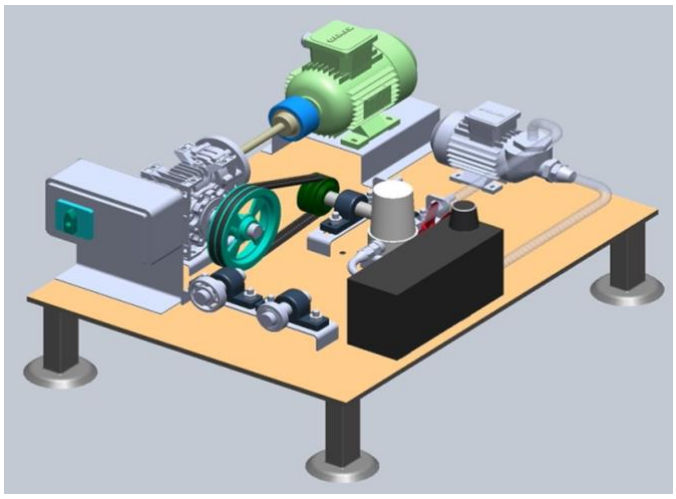
Oil which is stored in oil container is transmitted to oil cooling radiator through lubricating oil pump which triggered by electrical motor. Refrigerated oil which is cooled is percolated through cartridge filter via pump pressure. This process circulates to oil container.

As first implementation finished, technical changes on the machine were done considering candidates' comments.

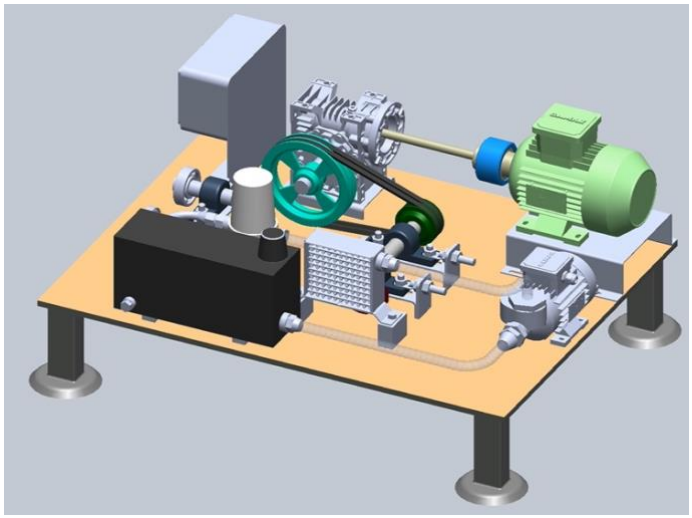
- During cooling process, oil cooling radiator was added in front of the fan.
- In circuit A, alteration on motor montage connection support bracket was done to calibrate axial and lateral of coupler which enables connection between electrical motor and reductor. This change created chance to adjustment opportunity.
- In certain maintenance periods, to change oil, oil discharge tap was added.

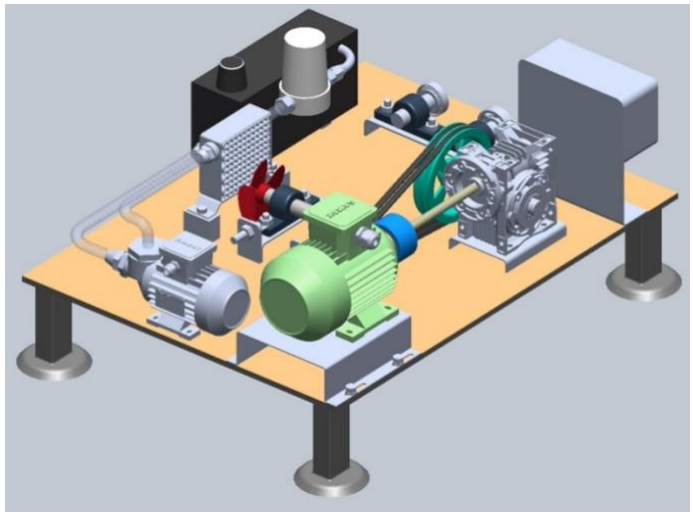
Initial Version of the Proto-type Machine

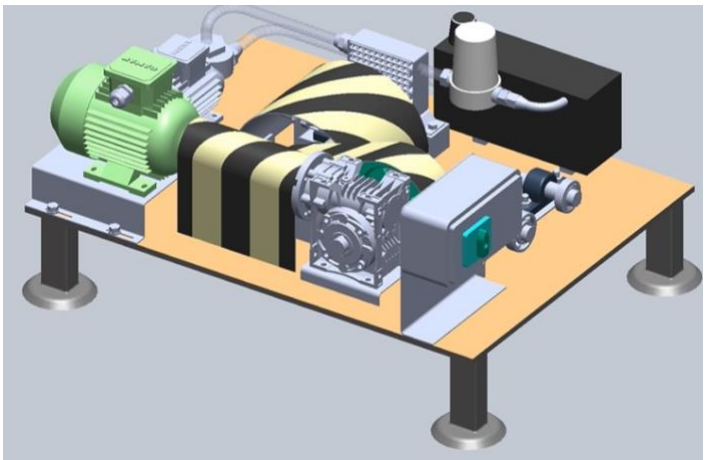




Final version of the Proto-type Machine







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APPENDIX

MACHINE MAINTENANCE LEVEL 3			
ABOUT THE PARTICIPANT			
ID No: Name, surname:		Signature:	
ABOUT THE APPLICATION			
Application Name: SMART COMET Pilot Application Date:		Place: Time:	
ABOUT THE QUALITION UNIT			
Qualification Units	Exercises	Duration	Success Rate
10UY0002-3/A1: Occupational Health and Safety, Environment and Quality	20		
10UY0002-3/B1: Preventive Maintenance	25		
10UY0002-3/B2: Corrective Maintenance	20		

10UY0002-3/A1: Occupational Health and Safety, Environment and Quality
This section involves 20 exercises.

1 Human-caused faults in Industries are the most common cause of emergency.

Which of the following **is not** among the reasons**?**

a) Inadequate training
b) Insufficient maintenance / repair
c) Safe working
d) Excessive fatigue

2 Which of the following statement is the first in the causes of an accident?

a) Insecure movement
b) Inexperience
c) Unexpected causes
d) Disease

3 What is the meaning of below security sign?

a) Use Glows
b) Use ear plug
c) Fire hazard
d) Use face mask

4 Which of the following is **not available** in first aid locker?

a) Pain reliever
b) gauze
c) Oxygen water
d) Wound band

5 Which of the following item **is not** correct information about fire extinguishers**?**

a) Be in visible and accessible locations
b) There should be no obstacles in front of them
c) Be in accordance with the nature of work being done
d) There must be a 6 kg of fire extinguisher for each 100 m2

6 What is the meaning of hazard symbol shown in the below figure?

a) Explosive substance

b) Toxic substance

c) Prohibited substance

d) Flammable material

7 What is the meaning of below security sign?

a) Use Glows

b) Use ear plug

c) Fire hazard

d) Use safety shoes

8 Which of the following statement is **wrong** for the emergency exit doors?

a) The number and the placement must be determined according to the number of employees

b) Must be locked and not connected

c) Must open to inward

d) It should not be a railed or revolving door

9 Which of the following **is not** the cause of a job accident**?**

a) Unprotected machines

b) Defective or slippery floor/ground

c) Use of personal protectors

d) Insufficient lighting

10 Which of the following item is necessary in the emergency action plan?

a) Fire

b) Earthquake

c) Chemical substance leakage

d) All

11 Which of the following emergency statement is proposed during the maintenance of a machine?

a) Continues to work

b) Informs to colleagues

c) An environmental abnormality report is prepared

d) The possibility of intervention is investigated and informed to the professional teams

12 Which of the following is eye-catching color?

a) White

b) Purple

c) Yellow

d) Red

13 Which unit is used for the measure of a sound intensity?

a) Decibel

b) Parameters

c) Histogram

d) Seismograph

14 Employee Ramazan, a pointed object falls into his head while working at his job and then Ramazan had a work accident.

In order to avoid such an accident, which of the following safety measures have to be taken by Ramazan?

a) Must use a helmet**.**

b) Must wear gloves.

c) Use protective goggles.

d) Must wear work wear

15 What is the color of the recycling bin for collection of plastic and metal products?

a) Blue

b) Yellow

c) Green

d) Grey

16 Which one of the following **<u>is not</u>** the cause of wastage**?**

a) Un-education

b) Advertisements that are blown away

c) Slow development of fashion

d) Determination of needs by others

17 Which of the following can be occurred, if quality-specified technical procedures **<u>are not properly applied</u>** during maintenance and repair?

a) Producing of quality products

b) A safe and peaceful working environment

c) Incorrect production

d) Production without any deviation

18 What is the purpose of quality control processes in general?

a) To examine the material structure of the product

b) To determine the conformity of the product or work to specified standards

c) To control the design features of the product

d) To check the dimensions of the product

19 What is called the confirmation process based on objective evidence that the specified conditions are fulfilled?

a) Verification

b) Recovering

c) Error

d) Check

20 What are the activities to remove the root cause of a specified non-conformity and preventing to be reproduced?

a) Improvement

b) Preventive action

c) Corrective action

d) Review

This section is done.
Please move on to the next section.

10UY0002-3/B1: Preventive Maintenance
This section involves 25 exercises.

1 What should be done after the cleaning of the cotton and fabric staffs used for cleaning?

a) Should be discarded.

b) Must be returned to unused staffs.

c) It should be left on the machine base.

d) Must be disposed into used staffs.

2 Which of the following is the most appropriate action to be taken in maintenance work to prevent strangers from entering the work area?

a) Lock the workshop door

b) Keep someone at the workshop entrance

c) Attract safety band to work area

d) Work during the holidays

3 Dirt, dust and accumulated oil in the machines or the removed assemblies are **not cleaned** by any of the following?

a) Broom

b) Vacuum pumps

c) High power vacuum cleaner

d) Vacuum generators

4 Which of the following is **not a good** lighting pattern?

a) Adequate light intensity

b) Spread well lighting

c) No shadow and no dazzling lighting

d) Dimmed light

5 Which of the following has a lever, sprocket and screw in the working system?

a) Hydraulic jack
b) Mechanical jack
c) Pneumatic jack
d) Electric power jack

6 Which of the following is **not the task** of the cranes?

a) Fast and serial load lifting
b) Light load lifting
c) Load weighing
d) Goods transportation

7 Which of the below parts should be kept as the spare in inventory for the machines used in the production line?

a) Working head
b) Base body
c) Drive motor
d) Bearing

8 Which of the following is **not considered** as consumable item for maintenance?

a) Belt
b) Rust remover spray
c) Gear
d) Bearing

9 Which of the following produces the compressed air required for the pneumatic circuit?

a) Hydraulic pump

b) Compressor

c) Conditioners

d) Pneumatic pumps

10 What is the device that hydraulic oil pressure measured?

a) Thermometer

b) Barometer

c) Torque-meter

d) Manometer

11 Which of the following should a machine maintainer perform periodic maintenance work according to?

a) His desire

b) The machine operating instructions

c) In case of failure

d) The maintainer's request

12 What should be the air pressure that feeds the universal machines used in the workshops?

a) 2 Bars

b) 6 Bars

c) 12 Bars

d) 16 Bars

13 Which of the following phrases defines? “Extends the machine's life, protects against corrosion, makes it work quietly."

a) Cooling liquid

b) Lubricate

c) Clean the machine

d) Regular work

14 Which of the following oil type should be used in the Reducer, Transfer box, etc?

a) Transmission oil

b) Engine oil

c) Hydraulic oil

d) Grease oil

15 During the (monthly) periodic maintenance of an air compressor, which of the following elements have to be checked for loosening and adjustment?

a) Manometer

b) V-Belt

c) Water trap filter

d) Air filter

16 Which of the following is included in the daily maintenance activity of a lathe?

a) Motor Belt Replacement

b) Replacement of cutter and cutting bit

c) Replacement of coolant filter

d) Cleaning of chuck and jaws

17 Which of the following materials **cannot be used** when cleaning sensitive machine parts during preventive maintenance?

a) Cotton cleaning cloth
b) Compressed air
c) Cleaning solvent
d) Soft brush

18 What is the fluidity characteristic of oils?

a) Flowability
b) Flow rate
c) Viscosity
d) Temperature

19 What is the name of the machine part with the variously rolling parts to make it easier to rotate a shaft?

a) Gear
b) Wedge
c) The hub
d) Bearing

20 What should be called materials such as Bearing, Belt, Filter and Oil, which should be changed periodically on a machine?

a) Consumables
b) Chemical materials
c) Service materials
d) Slow moving materials

21 Which of the following options should need to be adjusted after the mechanical friction system has been changed?

a) Coupling (clutch) clearance

b) Bearing clearance

c) Pad space

d) Bearing space

22 Which one of the following settings is **not applied** on the shaft that transmits the motion between the two units via a mechanical coupling connection?

a) Axial spacing

b) Axial travel

c) Offset setting

d) Coupling parallax

23 Which of the following is **not covered** by autonomous care?

a) Cleaning of the machine by operator

b) Control of the machine by operator

c) Lubricating of the machine by operator

d) Performing major repair of the machine by operator

24 Which of the below procedure is followed after maintenance and repair of a machine?

a) Fill in maintenance form

b) Inform to the supervisor

c) Check whether the machine operates properly

d) All

25 Which of the following forms will be filled after periodic maintenance on a machine has been completed?

a) Periodic maintenance form

b) Assembly form

c) Control form

d) Repair form

This section is done.
Please move on to the next section.

10UY0002-3/B2: Corrective Maintenance
This section involves 20 exercises.

1 Which of the following item is **not necessary** for the welding area in a maintenance workshop?

a) Welding goggle

b) Welding glove

c) Hydrant

d) Fire extinguisher

2 Which of the following behaviors is **wrong** in the electrical maintenance and repair work on the machines?

a) Working with isolated instruments

b) Cut off the electric supply of the machine

c) Wearing insulated shoes

d) Working on wet ground

3 Which of the following terms refers to *"the reduction of air pressure to atmospheric pressure"*?

a) Pressure

b) Atmosphere

c) Vacuum

d) Steam

4 Which of the following is **not a correct statement** for the safety of flammable and combustible materials?

a) Do not interfere oxygen tubes with oily hands and gloves

b) The materials are stored in the special area according to the instructions

c) The materials are set to the usage parameters according to the instructions

d) Materials may be kept in resting and sitting areas

5 Which of the following information is included in the manuals for maintenance, repair and use of the machines?

I. *Technical features of machine*

II. *Machine lubrication system*

III. *Assembly pictures of the machine*

a) Only I

b) I and II

c) I and III

d) All

6 Which criteria are considered when selecting power transfer belts?

a) Stiffness of the belt

b) Belt's brand

c) The belt sizes

d) Belt's material content

7 The main shaft bearings will be changed. Which of the following factors is **not taken** into account when choosing a bearing?

a) Bearing type

b) Bearing code

c) Bearing size

d) Bearing brand

8 Which of the following item is **not considered** as consumable for an air compressor?

a) Belt

b) Filter

c) Piston

d) Oil

9 Which of the following tools will be used to remove the bearings for maintenance and repairs?

a) Lever

b) Puller

c) Hummer

d) Screwdriver

10 Which of the following is **not a measuring** instrument?

a) Torque wrench

b) Micrometer

c) Manometer

d) Thermomete

11 Which statement is true regarding the dismantling of defective machine parts?

a) The dismantled parts are arranged in rows.

b) The disassembled parts are collected in the box.

c) The disassembled parts are placed on the machine.

d) The dismantled parts are stored by an assitant

12 A machine is equipped with electrical, compressed air and closed type cooling water supply lines; Before starting to work, which of the following supply lines must be turned off in sequence?

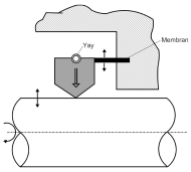
e) Air, Water, Electricty

f) Electricity, Air, Water

g) Water, Air, Electricity

h) Air Electricity, Water

13



What type of the sealing element is seen in above picture?

a) Staffing

b) Radial felt

c) O-ring

d) Seal

14 What is the name of the machine element that transfers a linear motion into a circular motion with the aid of an arm?

a) The crankshaft

b) Arbor shaft

c) Camshaft

d) Lay shaft

15 Disassembly and reassembly of the lower oil sump housing in the machines, which of the following parts should be replaced with the new one?

a) Fixing bolts

b) Oil seal gasket

c) Caster centering pins

d) Oil filler cap

16 Which of the following constitutes a group of spare parts for which a machine must be replaced under maintenance repair or periodic maintenance?

a) Gear, Belt, Shaft, Oil, Filter

b) Filter, Bolt, Nut, O-ring, Washer

c) Oil, Filter, Gasket, Gear, Plug

d) Bearing, Gasket, Oil, Belt, Filter

17 Which of the following documents is required for the procedure of periodic maintenance and repair?

a) Maintenance Repair Form

b) Assembly Form

c) Purchase Form

d) Material Request Form

18 Which of the following must be done after the maintenance and repair of the machines?

a) Start working immediately

b) Informing to supervisor and continue to work

c) The machine is shut down and cannot be operated

d) Expected instruction from top management

19 Which of the following information is **not presented** on the form for maintenance and repair?

a) List of materials used

b) Start and end time

c) Explanation of work done

d) Maintenance and repair cost

20 Why is the "start and end time" written on the maintenance repair form?

a) To measure annual machine performance

b) To measure machining capacity

c) To measure the performance of the operator

d) To measure the performance of maintenance staff

This section is done.
Please check your applications.