1. Maintenance within Physical Asset Management

1.1. Physical Asset Management

Overview

- Very good knowledge in the concept of Physical Asset Management
- Ability to interpret the company policy
- Relations between maintenance and other processes
- Relevant company procedures (EN 15628:2014 C.1:a)
- Relevant business and company strategies, targets and business processes (EN 15628:2014 C.1:b)
- Industrial relations (EN 15628:2014 C.1:j)
- Fundamentals of processes and projects management (EN 15628:2014 C.2:d)
- Maintenance within physical asset management (EN 15628:2014 C.2:i)
- Procedures and business processes (EN 15628:2014 C.4:a)
- Quality management system (EN 15628:2014 C.4:c)
- Corporate objectives (EN 15628:2014 C.5:e)
- Targets of other departments that interact with maintenance (EN 15628:2014 C.6:e)
- Break down the company policy into a maintenance policy
- Follow the development of the relationships with technical organizations, institutes and associations for the issues concerning the area of maintenance (EN 15628:2014 C.1:f)
- Ensure the implementation of company policies for the organization, management and training of employees (EN 15628:2014 C.3:b)
- Ensure the communication between different organizational levels and business processes (EN 15628:2014 C.3:d)

Subject	Knowledge	Skills	Responsibility and autonomy
1.1.1 Physical Asset Management	**A maintenance manager should be able to:** – Describe Physical Asset Management and its effects on the maintenance processes	**A maintenance manager should be able to:** – Implement a maintenance organisation according to the Physical Asset Management	**A maintenance manager should be able to:** – Manage the work for planning maintenance in a total project
1.1.2 Company processes	**A maintenance manager should be able to:** – Describe company strategies, targets and business processes – Mention legislation, technical standards, management system for safety, health, environment and quality, company's and external specialist resources – Describe processes and projects management	**A maintenance manager should be able to:** – Adapt maintenance strategies, targets and business to the company´s processes	**A maintenance manager should be able to:** – Carry out maintenance planning as a part of total investment in a total project

Qualifications for Maintenance Managers (EQF level 7)

1.1.3 Company policy	**A maintenance manager should be able to:** – Describe in detail how to set up a company management policy in order to be able to participate in its definition as far as maintenance is concerned – Describe why a policy has to be set up and what the requirements are for a policy – Giving examples on in which way the maintenance aspects are in a company management policy	**A maintenance manager should be able to:** – Interpret and carry out the company policy – Adapt the maintenance policy to the company´s policy	**A maintenance manager should be able to:** – Support the management with the key maintenance part in the total company policy
1.1.4 Quality and Environmental regulations and systems	**A maintenance manager should be able to:** – Describe quality and environmental regulations and systems – Describe the basics in recommended environmental activities	**A maintenance manager should be able to:** – Follow quality and environmental regulations	**A maintenance manager should be able to:** – Adapt the maintenance plan to the company strategical quality and environmental plan including capability to follow up results
1.1.5 Maintenance within Physical Asset Management	**A maintenance manager should be able to:** – Describe data that is needed for maintenance within Physical Asset Management – Describe the standard EN 16646:2014 Maintenance within physical asset management – Explain the relations between maintenance and other processes – Mention systems for production planning, account system, maintenance planning and CMMS, and the relation between them	**A maintenance manager should be able to:** – Define what data is needed for maintenance within Physical Asset Management – Identify the company´s different processes – Communicate with different organizational levels and business processes	**A maintenance manager should be able to:** – Develop and carry out a maintenance plan according to the Physical Asset Management plan

References

ISO 55000:2014 – Asset management Overview, principles and terminology:

– This standard gives an overview of asset management, its principles and terminology, and the expected benefits from adopting asset management. It can be applied to all types of assets and by all types and sizes of organizations.

EN 16646:2014 – Maintenance within physical asset management:

- This standard introduces physical asset management as a framework for maintenance activities. It also introduces the relationship between organizational strategic plan and maintenance management system and describes the interrelations between maintenance process and all the other physical asset management processes. It addresses the role and importance of maintenance within physical asset management system during the whole life cycle of an item. It can be applied to production organizations of all sizes and consists of guidance and recommendations.

1.2. Production

Overview

- Very good knowledge in the relation between maintenance and production planning, safety and quality
- Legislation, technical standards, management system for safety, health, environment and quality, company's and external specialist resources (EN 15628:2014 C.1:c)
- Principles, logic and parameters of operation and utilization of items and assets (EN 15628:2014 C.1:f)
- Ensure compliance with legislation, technical standards and company strategies, objectives and procedures on safety, health, environmental protection and quality (EN 15628:2014 C.1:b)
- Evaluate the technical capability according to the specifications and the needs for selection of suppliers (EN 15628:2014 C.7:a)

Subject	Knowledge	Skills	Responsibility and autonomy
1.2.1 Production planning	**A maintenance manager should be able to:** – Explain the relations between the production planning regarding maintenance affects	**A maintenance manager should be able to:** – Adapt the maintenance plan according to adjustments in both production and maintenance planning	**A maintenance manager should be able to:** – production planning
1.2.2 Production safety	**A maintenance manager should be able to:** – Describe what affects the production safety regarding maintenance – Explain different types of incidents that the maintenance activities shall prevent (e.g. consequences on health, safety and environment) – Describe predicted, and prevent safety consequences	**A maintenance manager should be able to:** – Plan and act preventively and/or correctively to increase production safety	**A maintenance manager should be able to:** – Develop and integrate safety system in the production control system

	– Giving examples of external parties interested in production safety preventions		
1.2.3 Production quality	**A maintenance manager should be able to:** – Describe the essential contribution from the maintenance activities to achieve good product quality – Explain how quality production is formed by personal engagements – The basics in TQC Total Quality Control – Defining quality and quality assurance – Standards and methods for quality assurance regarding maintenance – Explain how maintenance activities will have an influence on the production quality	**A maintenance manager should be able to:** – Plan and act preventively and/or correctively to maintain or increase production quality	**A maintenance manager should be able to:** – Verify that needed maintenance activities are integrated in the production quality activities

References

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EN 16646:2014 – Maintenance within physical asset management:

- This standard introduces physical asset management as a framework for maintenance activities. It also introduces the relationship between organizational strategic plan and maintenance management system and describes the interrelations between maintenance process and all the other physical asset management processes. It addresses the role and importance of maintenance within physical asset management system during the whole life cycle of an item. It can be applied to production organizations of all sizes and consists of guidance and recommendations.

2. Maintenance Management

2.1. Maintenance management

Overview

- Very good knowledge in Maintenance Management
- Ability to manage maintenance

Subject	Knowledge	Skills	Responsibility and autonomy
2.1.1 Maintenance management	**A maintenance manager should be able to:** – Describe Maintenance Management and the different parts in the process	**A maintenance manager should be able to:** – Implement an effective maintenance management process	**A maintenance manager should be able to:** – Manage maintenance activities in the total working requirements
2.1.2 Maintenance policy	**A maintenance manager should be able to:** – Define the general requirements for a maintenance policy – Describe how to formulate a maintenance policy – Give an example of a maintenance policy – Describe the process of the development of a maintenance	**A maintenance manager should be able to:** – Carry out and formulate a maintenance policy based on the company´s policy	**A maintenance manager should be able to:** – Develop a maintenance policy
2.1.3 Maintenance objectives	**A maintenance manager should be able to:** – Define the general requirements for maintenance objectives – Give example of maintenance objectives – Describe the process of the development of maintenance objectives – Describe the relationship between the objectives and the policy	**A maintenance manager should be able to:** – Carry out and formulate maintenance objectives based on the maintenance policy	**A maintenance manager should be able to:** – Perform controlling parts in the company's maintenance objectives
2.1.4 Maintenance strategies	**A maintenance manager should be able to:** – Describe different maintenance strategies	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**

	– Explain how to choose the right strategy – Describe the reasons behind the choice of a certain strategy – Explain ways for modelling and simulation (Twins) of maintenance strategies	– Define and implement maintenance strategies based on the maintenance policy and strategies	– Develop strategies in relation to specific production lines
2.1.5 Key Performance Indicators (KPI)	**A maintenance manager should be able to:** – Mention Key Performance Indicators for the economic and technical control – Describe how to use the Key Performance Indicators in the control and development of the maintenance activities – Define what the fundamental requirements are for Key Performance Indicators – Describe the most useful Key Performance Indicators for different maintenance organizations	**A maintenance manager should be able to:** – Choose and use relevant key performance indicators (KPI) for technical and economical control	**A maintenance manager should be able to:** – Present various KPI´s

References

EN 17007:2017-MAN.1 – Establish the maintenance policy, strategy and development actions:

- Based on the company's missions, values, regulations compliance and general objectives, the policy establishes the direction, which gives priority to:
  - Safety of individuals and items, product quality, environmental protection.
  - Availability and useful life of the items.
  - Optimization of maintenance costs, etc.
- The maintenance strategy, which results from the maintenance policy, requires that choices be made for:
  - Developing, adapting or implementing maintenance methods.
  - Organizing the internal resources (maintenance teams, stocks of spare parts and consumables, documentation, tools, etc.).
  - Insourcing and/or outsourcing and/or contracting some or all the maintenance tasks.
  - Studying the economic impact of item modifications or improvements.
- The development of maintenance processes according to the strategy and the process to determine and prioritize improvements are defined and decided.

EN 17007:2017-MAN.5 – Oversee the actions:

- All the actions included in the maintenance process are coordinated, supervised and, if applicable, decided on by Management in order to achieve the goals and objectives defined in terms of safety, availability, costs, environment, quality, etc.

2.2. Maintenance economics and budgeting

Overview

- Good knowledge the basics in maintenance economics and budgeting
- Fundamentals of business administration and economy (EN 15628:2014 C.1:d)
- Fundamentals and tools of control management (EN 15628:2014 C.6:a)
- Principles, logic and parameters of operation and utilization of asset and item (EN 15628:2014 C.6:c)
- Develop the maintenance budget in accordance with business strategies, company strategies, objectives, and procedures and according to the current state of assets and their life cycle (EN 15628:2014 C.1:c)

Subject	Knowledge	Skills	Responsibility and autonomy
2.2.1 Maintenance economics	**A maintenance manager should be able to:** – Describe different economical models regarding maintenance – Describe fundamental principles regarding the economical results for a company – Describe the difference between direct and indirect maintenance costs	**A maintenance manager should be able to:** – Define, compile cost elements, and calculate or estimate actual costs (EN 17007:2017 BUD.1)	**A maintenance manager should be able to:** – Calculate individual maintenance works and put it together to a budget or following ups
2.2.2 Maintenance budget	**A maintenance manager should be able to:** – Describe the components in maintenance budgeting – Describe how to separate internal and external costs for personnel and spare parts	**A maintenance manager should be able to:** – Carry out budgets according to the processes: ▪ Create a budget and estimate for regular or infrequent or exceptional maintenance tasks (EN 17007:2017 BUD.2, EN 17007:2017 BUD.3) ▪ Extract budgeted and actual expenditures (EN 17007:2017 BUD.4) ▪ Analyse, explain and, if applicable, take corrective actions (EN 17007:2017 BUD.5)	**A maintenance engineer should be able to:** – Calculate individual maintenance works and put it together to a budget

2.2.3 Economical maintenance plan	**A maintenance manager should be able to:** – Describe how to develop economic maintenance plans distributed on activities and needed resources	**A maintenance manager should be able to:** – Prepare and negotiate the economical maintenance for activities, items, equipment and assets	**A maintenance manager should be able to:** – Calculate individual maintenance works and put it together to an economical plan

References

EN 17007:2017-MAN.4 – Prepare and negotiate the budgets:

- Economic plans (Budgets) are approved and adjusted by Management based on the budgeting process (BUD).

EN 17007:2017-BUD – Budget maintenance of items:

- Schedule economic planning (short, medium and long-term) based on a defined cycle, for regular maintenance (expenditures and costs related to the company's operation) and exceptional maintenance (investments) activities.

2.3. Maintenance activities

Overview

- Very good knowledge in different internal and external maintenance activities
- Technical and commercial risk assessment related to maintenance aspects (EN 15628:2014 C.2:j)
- Control the compliance with the maintenance budget, identifying any corrective action in case of noncompliance (EN 15628:2014 C.6:d)

Subject	Knowledge	Skills	Responsibility and autonomy

Qualifications for Maintenance Managers (EQF level 7)

2.3.1 Requirements for maintenance activities	**A maintenance manager should be able to:** – Describe the different maintenance activities – Define different requirements for the maintenance activities – Describe the process of the identification, formulation, and the communication of the requirements of different maintenance activities	**A maintenance manager should be able to:** – Manage maintenance activities in relation to the production requirements	**A maintenance manager should be able to:** – Analyse the technical requirements and based on that plan the work
2.3.2 Quality assurance of maintenance activities	**A maintenance manager should be able to:** – Describe how to guide, control and analyse the maintenance activities – Describe different methods and techniques to achieve an optimized result for the company by the maintenance activities, including the economical and safety aspects for these methods and techniques – Explain different general aspects that must be taken into account for analysis	**A maintenance manager should be able to:** – Carry out the work to guide, control and analyse the maintenance activities	**A maintenance manager should be able to:** – Quality assure the maintenance activities in relation to the quality in production
2.3.3 Analyse the results of maintenance activities	**A maintenance manager should be able to:** – Describe how to analyse the results of maintenance activities – Explain different methods to measure the result of the maintenance activities, the advantages and disadvantages with the methods and their handling of the economic aspects and what is not covered by these methods	**A maintenance manager should be able to:** – Develop models for measurement and analysis of the maintenance activities	**A maintenance manager should be able to:** – Analyse the pros and cons in results of maintenance activities
2.3.4 Life cycle extension	**A maintenance manager should be able to:** – Explain different methods for life cycle extensions	**A maintenance manager should be able to:** – Carry out and define strategies for life extensions	**A maintenance manager should be able to:** – long term thinking based on achieved information from operation and models to create strategies for life cycle extension

2.3.5 Operator maintenance	**A maintenance manager should be able to:** – Explain what operators should do regarding maintenance – Explain how operators should report tasks	**A maintenance manager should be able to:** – Support the production with knowledge, maintenance activities and resources for operator-based maintenance	**A maintenance manager should be able to:** – Analyse suitable activities for operators and adapted information for acceptance of technical and economic goals

References

EN 17007:2017-MAN.2 – Identify the internal or external activities:

– The maintenance policy and strategy make it possible to clearly identify the activities carried out internally and those assigned to participating companies. In connection to budgeting this identification leads to choosing between those assigned to participating companies and between “making” and “buying” and specifying the required skills.

2.4. Maintenance organisation

Overview

– Good knowledge in a maintenance organisation
– Organizational models (EN 15628:2014 C.3:a)
– Competence of employees (EN 15628:2014 C.3:f)
– Labour agreements of reference for the sector (EN 15628:2014 C.3:g)
– Identify the most appropriate organizational model to achieve corporate strategic objectives in terms of effectiveness and efficiency (EN 15628:2014 C.3:a)

Subject	Knowledge	Skills	Responsibility and autonomy
2.4.1 Maintenance organisation	**A maintenance manager should be able to:** – Describe different types of maintenance organizations (e.g. centralized, decentralized, co-operation with the equipment supplier and/or servicing companies and integration with the production) – Describe the advantages and the disadvantages with the different types of organizations and the combination of them including own and purchased resources	**A maintenance manager should be able to:** – Develop and maintain the competence in actual organization – Organize and control insourcing and/or outsourcing and/or contracting some or all the maintenance tasks	**A maintenance manager should be able to:** – Plan for maintenance organization using own and purchased resources

2.4.2 Jobs and competences	**A maintenance manager should be able to:** – Describe how to assure the right competence within the organisation	**A maintenance manager should be able to:** – Define the needed jobs and competences for the maintenance work force	**A maintenance manager should be able to:** – Analyse needed competence for the various types of work and mapping status of existing labour force
2.4.3 Labour laws and regulations	**A maintenance manager should be able to:** – Explain relevant national laws and regulations	**A maintenance manager should be able to:** – Follow the required labour laws and regulations for maintenance work	**A maintenance manager should be able to:** – Plan and carry out maintenance tasks according to labour agreement and legislation in labour market

References

EN 17007:2017-MAN.3 – Determine the organization, job profiles and responsibilities:

- Based on the direction and choices expressed in the policy and strategy, an organization is set up to realize the maintenance processes. Tasks and job profiles are established as well as possible needs to update present skills Responsibilities are defined and assigned to the company's personnel.

2.5. Leadership, training and coaching

Overview

- Very good knowledge in technical training and coaching methods and techniques
- Ability to lead, train and coach working groups
- Communication techniques (EN 15628:2014 C.1:e)
- Professional leadership (EN 15628:2014 C.1:h)
- Management of working groups (EN 15628:2014 C.1:i)
- Technical training and upgrading (EN 15628:2014 C.3:d)
- Collaborate in the definition of individual professional development according to the company policies (EN 15628:2014 C.3:c)
- Define needs and proposals for recruitment plans, training of the employees and for the development of the organization (EN 15628:2014 C.3:e)
- Perform professional leadership, communication techniques and management of working groups (EN 15628:2014 C.5:a)
- Collaborate in the design of training courses and coaching of maintenance personnel to ensure continuous improvement of professional competencies (EN 15628:2014 C.5:h)
- Present and visualize, such as for maintenance budget, Human Resources requests of additional capital expenditures (EN 15628:2014 C.5:i)

Subject	Knowledge	Skills	Responsibility and autonomy
2.5.1 Communication and	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**

presentation techniques	– Explain pedagogical methods to communicate and present in the best way	– Professionally communicate and present actual and relevant information	– Understand and practise different pedagogical ways to communicate relevant information both oral and in text
2.5.2 Leadership	**A maintenance manager should be able to:** – Explain the basics in a professional leadership	**A maintenance manager should be able to:** – Use a professionally leadership as a manager	**A maintenance manager should be able to:** – Practice a professionally leadership regarding to actual situation
2.5.3 Methods and techniques for training	**A maintenance manager should be able to:** – Explain actual local needs within competence for technical education and training – Explain International qualifications for maintenance work	**A maintenance manager should be able to:** – Plan, organise and execute education and training	**A maintenance manager should be able to:** – Use different pedagogical ways to transfer subjects in respect of used machinery
2.5.4 Coaching	**A maintenance manager should be able to:** – Mention coaching methods for improving maintenance	**A maintenance manager should be able to:** – Coach the employees in a professional manner	**A maintenance manager should be able to:** – Use methods for supporting labour force in the process to be more efficient
2.5.5 Working groups	**A maintenance manager should be able to:** – Mention different types of working groups	**A maintenance manager should be able to:** – Manage working groups	

References

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3. Maintenance Execution

3.1. Failure and fault theory

Overview

- Understanding in theories regarding failures and faults
- Ensure failure analysis on critical assets, in order to identify the root causes and propose actions (EN 15628:2014 C.4:g)

Subject	Knowledge	Skills	Responsibility and autonomy
3.1.1 Failure patterns	**A maintenance manager should be able to:** - Mention the mechanism that causes the failures - Describe the theory of failure patterns - Describe the definitions of a failure and a fault - Mention different causes for a fault (e.g. specification, design, installation, operation, maintenance) - Mention different types of human failures and what causes them - Mention how human failures can be prevented and avoided - Describe different statistical distributions for failures (e.g. Exp, Ln, Weibull, etc.)	**A maintenance manager should be able to:** - Plan and organize the work that characterize undesirable events (EN 17007:2017 PRV.1) - Plan and organize the work - Characterize and prioritize failures, malfunctions due to latent or hidden faults that can have harmful and significant consequences on availability, reliability, personal safety, the environment, product or service quality, the value of the assets and costs - Choose the appropriate maintenance method depending on the actual failure distribution (e.g. corrective, preventive, condition based, modification) - Classify and consider the different consequences of a fault - Analyse the result obtained to make it possible to define the actions to be taken in order to avoid these events or control their consequences - Perform a human error analysis	**A maintenance manager should be able to:** - Manage the process to identify different types of failures and used maintenance methods to improve the processes.

3.1.2 Wear and tear	**A maintenance manager should be able to:** – Describe different types of wear and tear – Describe how to avoid wear and tear	**A maintenance manager should be able to:** – Plan for counteractions to minimize wear and tear	**A maintenance manager should be able to:** – Optimize the process to take care of the maintenance tasks related to wear and tear
3.1.3 System and functional analysis	**A maintenance manager should be able to:** – Describe how processes are designed and programmed for preparing activities for troubleshooting and modification	**A maintenance manager should be able to:** – Plan for system and functional analysis – Manage activities for troubleshooting and modification	**A maintenance manager should be able to:** – Plan for functional analysis with the goal to optimize the process and CBM methods

References

EN 17007:2017-PRV – Prevent undesirable events by avoiding failures and faults:

- Characterize and prioritize the events (failures, malfunctions due to la-tent or hidden faults) that can have harmful and significant consequences on availability, reliability, personal safety, the environment, product or service quality, the value of the assets and costs. (PRV.1)
- Determine the actions to be taken on the items to achieve the objectives set in the maintenance policy (availability, reliability, safety, costs, etc.). (PRV.2)

3.2. Planning and scheduling

Overview

- Good knowledge in planning and scheduling
- Fundamentals of planning and scheduling (EN 15628:2014 C.2:c)
- Principles and methods for planning and controlling (EN 15628:2014 C.5:f)
- Ensure the execution of maintenance plans (EN 15628:2014 C.4:d)
- Ensure the proper execution of maintenance work (EN 15628:2014 C.6:b)

Subject	Knowledge	Skills	Responsibility and autonomy
3.2.1 Planning and scheduling	**A maintenance manager should be able to:** – Describe how to plan and schedule maintenance activities	**A maintenance manager should be able to:** – Implement an effective planning and scheduling process in maintenance	**A maintenance manager should be able to:** – Develop and follow up maintenance plans including optimizing activities
3.2.2 Prioritizing maintenance activities	**A maintenance manager should be able to:** – Described different prioritizing tools for maintenance	**A maintenance manager should be able to:** – Rank the maintenance events (EN 17007:2017 ACT.1)	

	– Describe an SLA (Service Level Agreement) for maintenance activities	– Prioritize the maintenance events in short or medium terms according to their importance and realization constraints	
3.2.3 Maintenance plans	**A maintenance manager should be able to:** – Describe in detail the principal for maintenance planning and how to keep the plans up to date in working conditions	**A maintenance manager should be able to:** – Create, use and update the Maintenance Plans (EN 17007:2017 PRV.2) – Determine the actions to be taken on the items to achieve the objectives set in the maintenance policy (availability, reliability, safety, costs, etc.)	
3.2.4 Work order process	**A maintenance manager should be able to:** – Explain the different steps in the work order process; planning, scheduling, realization, reporting and the work orders connection to CMMS	**A maintenance manager should be able to:** – Prepare maintenance information to complete maintenance tasks safely	**A maintenance manager should be able to:** – Coordinate and develop the process aiming to improve CMMS
3.2.5 Maintenance planning	**A maintenance manager should be able to:** – Describe maintenance planning – Describe different tools for maintenance planning – Explain how to use real time data for forming maintenance	**A maintenance manager should be able to:** – Set the timeline of the planned tasks in order, based on the sequencing constraints and constraints related to required resources (material, human, etc.) to create a schedule that considers any uncertainties that may arise, according to the processes: ▪ Prepare maintenance resources for the tasks (EN 17007:2017 ACT.2) ▪ Set in order the maintenance tasks (EN 17007:2017 ACT.3) – Choose a suitable preventive maintenance program (e.g. activities, intervals, etc)	**A maintenance manager should be able to:** – Guide and control the maintenance work based on developed activities via the CMMS
3.2.6 Maintenance scheduling	**A maintenance manager should be able to:** – Describe Maintenance scheduling in relation to production requirements	**A maintenance manager should be able to:** – Schedule the maintenance tasks (EN 17007:2017 ACT.4)	**A maintenance manager should be able to:** – Present in CMMS an active and living plan for maintenance activities

	– Describe different tools for maintenance scheduling	– Prepare the provisional schedule (start date, end date) of the tasks – Decide about the intervals between preventive maintenance actions	
3.2.7 Maintenance realization	**A maintenance manager should be able to:** – Describe different methods and techniques for maintenance realization	**A maintenance manager should be able to:** – Start, perform, and finalize the tasks by assigning the corresponding actions to the necessary individuals who are competent and available on the planned date of the tasks according to the processes: ▪ Begin the scheduled maintenance tasks (EN 17007:2017 ACT.5) ▪ Perform the scheduled maintenance tasks (EN 17007:2017 ACT.6) ▪ Finish the scheduled maintenance tasks (EN 17007:2017 ACT.7) – Prepare for using digital twins as a tool for improvements	**A maintenance manager should be able to:** – Initiate and realize a planned maintenance program and eventually use twin techniques for improvements
3.2.8 Verification before start	**A maintenance manager should be able to:** – Explain the principles of verification tests and measures before start	**A maintenance manager should be able to:** – Assure that verification before start is executed properly all the time	**A maintenance manager should be able to:** – Develop activities before first start and restart after maintenance activities

References

EN 17007:2017-ACT – Act preventively and/or correctively on the items to maintain:

- The events to deal with in the short or medium term with preventive maintenance (potential or actual failures) are prioritized according to their importance and realization constraints. A ranked list of events is established and updated continuously. (ACT.1)
- Prepare the maintenance information needed to complete a maintenance task safely. (ACT.2)
- Set in order the timeline of the planned tasks based on the sequencing constraints and constraints related to required resources (material, human, etc.) in order to create a schedule that takes into account any uncertainties that may arise. (ACT.3)
- Prepare the provisional schedule (start date, end date) of the tasks. (ACT.4)

3.3. Preventive maintenance

Overview

- Good knowledge in preventive maintenance activities
- Ensure the preservation of assets according to their useful life (EN 15628:2014 C.6:e)

Subject	Knowledge	Skills	Responsibility and autonomy
3.3.1 Preventive maintenance	**A maintenance manager should be able to:** – Describe preventive maintenance and the different strategies to ensure a high dependability	**A maintenance manager should be able to:** – Plan and implement an effective preventive maintenance plan	**A maintenance manager should be able to:** – Analysing and optimizing the process all activities in preventive maintenance
3.3.2 Predetermined maintenance	**A maintenance manager should be able to:** – Describe methods and techniques for predetermined maintenance – Describe how to perform predetermined maintenance	**A maintenance manager should be able to:** – Realize plans for predetermined maintenance	**A maintenance manager should be able to:** – Analysing and optimizing the process all activities in predetermined maintenance
3.3.3 Condition-based maintenance	**A maintenance manager should be able to:** – Describe methods and techniques for condition-based maintenance (e.g. subjective and objective condition-based maintenance methods) – Describe different types of condition monitoring systems (e.g. continuous, by intervals, on request, centralized or decentralized) – Describe P-F Interval and how it is used – Describe methods and techniques for inspection (condition-based maintenance) – Explain how to perform non-predictive maintenance	**A maintenance manager should be able to:** – Decide about the intervals between inspections and condition-based maintenance – Choose a suitable inspection and condition-based maintenance system – Decide where non-predictive maintenance should be carried out	**A maintenance manager should be able to:** – Analyse and optimize the process for all condition-based maintenance tasks

3.3.4 Predictive maintenance	**A maintenance manager should be able to:** – Describe how to perform predictive maintenance – Describe predictive maintenance methods – Describe the difference between predictive and non-predictive maintenance	**A maintenance manager should be able to:** – Decide where predictive maintenance should be carried out – Choose suitable systems for predictive maintenance	**A maintenance manager should be able to:** – Analyse and optimize the process for all predictive maintenance tasks

References

EN 17007:2017-ACT – Act preventively and/or correctively on the items to maintain:

- Start the tasks by assigning the corresponding actions to the necessary individuals who are competent and available on the planned date of the tasks. (ACT.5)
- Restore the item to the required state. This restoration may be carried out either as a preventive measure or after a fault is detected. (ACT.6)
- Finalize the task by restoring the maintenance area, returning the item to the user and compiling the feedback. (ACT.7).

3.4. Corrective maintenance

Overview

- Good knowledge in corrective maintenance activities
- Ability to plan for restoration of the items to their required state
- Perform safeguarding, that immediate action is taken in cases of exceptional events (EN 15628:2014 C.5:b)

Subject	Knowledge	Skills	Responsibility and autonomy
3.4.1 Corrective maintenance	**A maintenance manager should be able to:** – Describe corrective maintenance and the different strategies to minimize unplanned stops	**A maintenance manager should be able to:** – Make decisions regarding corrective maintenance	**A maintenance manager should be able to:** – Analyse the result of corrective maintenance work to plan for preventive activities
3.4.2 Fault diagnosis	**A maintenance manager should be able to:** – Describe how to detect and diagnose faults – Describe the different fault detection and diagnose methods and techniques	**A maintenance manager should be able to:** – Detect faults, locate them, and identify the primary cause according to the processes: ▪ Classify the actual events (EN 17007:2017 COR.1)	**A maintenance manager should be able to:** – Analyse functions and system and find out where faults can be located

		▪ Diagnose the state of the items in question (EN 17007:2017 COR.2)	
3.4.3 Immediate Corrective Maintenance	**A maintenance manager should be able to:** – Describe the difference between immediate and deferred corrective maintenance – Describe the work when to perform immediate corrective maintenance	**A maintenance manager should be able to:** – Decide when a corrective maintenance action is considered to be immediate – Take immediate corrective action in cases of exceptional events	**A maintenance manager should be able to:** – Optimize the process to take care of rapid realization to minimise down time
3.4.4 Deferred Corrective Maintenance	**A maintenance manager should be able to:** – Describe the difference between immediate and deferred corrective maintenance	**A maintenance manager should be able to:** – Decide when a corrective maintenance action is deferred	**A maintenance manager should be able to:** – Optimize the process to minimise down time
3.4.5 Restoration techniques	**A maintenance manager should be able to:** – Describe different restoration techniques	**A maintenance manager should be able to:** – Decide which restoration technique to use	**A maintenance manager should be able to:** – Optimize restoration activities for minimizing down time

References

EN 17007:2017-COR – Restore the items to their required state:

- The actual events to deal with in the short or medium term with corrective maintenance are prioritized according to their importance and realization constraints. A ranked list of events is established and updated continuously. (COR.1)
- Detect any faults, locate them and identify the primary cause(s). (COR.2)

EN 17007:2017-ACT – Act preventively and/or correctively on the items to maintain:

- Start the tasks by assigning the corresponding actions to the necessary individuals who are competent and available on the planned date of the tasks. (ACT.5)
- Restore the item to the required state. This restoration may be carried out either as a preventive measure or after a fault is detected. (ACT.6)
- Finalize the task by restoring the maintenance area, returning the item to the user and compiling the feedback. (ACT.7).

3.5. Continuous improvement

Overview

- Very good knowledge in continuous improvements
- Seek relevant industry best practices and aim to implement locally (EN 15628:2014 C.1:k)
- Problem solving techniques (EN 15628:2014 C.4:h
- Principles and tools for the continuous improvement (EN 15628:2014 C.5:a)
- Process re-engineering techniques (EN 15628:2014 C.5:b)

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- Promote process re-engineering analysis and studies for maintenance and logistics with the aim to ensure the improvement of availability, reliability and maintainability and to optimize maintenance costs (EN 15628:2014 C.1:e)
- Improve availability, reliability, maintainability, supportability and the cost of life cycle of asset according to technical and commercial opportunities (EN 15628:2014 C.4:c)
- Ensure the process of re-engineering and continuous improvement of maintenance (EN 15628:2014 C.5:d)

Subject	Knowledge	Skills	Responsibility and autonomy
3.5.1 Continuous improvement	**A maintenance manager should be able to:** – Describe continuous improvement and what effect these will have on the dependability	**A maintenance manager should be able to:** – Develop and implement a continuous improvement programme	**A maintenance manager should be able to:** – Develop a way to work by picking up all ideas to improve and develop structural reforms
3.5.2 Improvement of items	**A maintenance manager should be able to:** – Describe methods for data collection – Show mathematical and statistical formulas to be used in the specifications and for verifications – Describe requirements regarding reliability performance (e.g. what is regarded as failures, active maintenance time, waiting time and how the availability is defined)) – Show the basic mathematical formulas within availability, reliability, maintainability and supportability – Describe how a verification will be performed – Describe consequences if the verified results are different from the requirements – Describe the different steps, and how to perform an RCA (Root Cause Analysis)	**A maintenance manager should be able to:** – Manage the organisation in the improvement of items according to the processes: ▪ Collect data (EN 17007:2017 IMP.1) ▪ Define reliability, maintainability, safety and logistic support requirements (EN 17007:2017 IMP.2) ▪ Establish specifications for the required improvements of the item (EN 17007:2017 IMP.3) ▪ Issue an invitation to tender to internal or external suppliers (EN 17007:2017 IMP.4) ▪ Analyse and choose options and validate the solutions (EN 17007:2017 IMP.5) ▪ Carry out realization (EN 17007:2017 IMP.6) ▪ Verify conformity with the reliability, maintainability, safety and logistic support requirements (EN 17007:2017 IMP.7) ▪ Establish the initial maintenance plan (EN 17007:2017 IMP.8)	**A maintenance manager should be able to:** – Use methods to support the process to improve the items aiming to optimize the production results

		▪ Determine the initial logistical resources (EN 17007:2017 IMP.9) ▪ Identify skills and training needs (EN 17007:2017 IMP.9) – Perform RCA analysis	
3.5.3 Improvement of results	**A maintenance manager should be able to:** – Describe different improvements techniques due to maintenance results – Show calculating OEE (Overall Equipment Effectiveness) – Describe different ways to improve the OEE	**A maintenance manager should be able to:** – Specify, plan, control and follow up improvements according to the processes: ▪ Determine areas for improvements, prioritize areas of improvements (EN 17007:2017 OPT.1) ▪ Prioritize areas of improvement related to other processes (EN 17007:2017 OPT.1 EN 17007:2017 OPT.5) ▪ Prioritize and specify modifications of existing items (EN 17007:2017 OPT.6) – Use the indicator OEE to measure and improve the results	**A maintenance manager should be able to:** – Use methods to take care of the results to improve to better conditions
3.5.4 Improvement techniques	**A maintenance manager should be able to:** – Describe different improvements techniques due to maintenance requirements: ▪ Kaizen ▪ TPM, Total Productive Maintenance ▪ PDCA; Plan, Do, Check, Act ▪ 5 why 1 how ▪ 5S, Systematic order in 5 steps ▪ 6M; Man, Machine, Method, Material, Measurement and Management ▪ 7QCT, Seven Quality Control Tools – Describe different methods of life extensions, and how to execute them	**A maintenance manager should be able to:** – Develop, plan and execute different improvement and life extension techniques	**A maintenance manager should be able to:** – Implement various methods and routines for improvements

	– Describe how different maintenance activities will have an influence on the lifetime of the production equipment		
3.5.5 Maintenance and industry 4.0	**A maintenance manager should be able to:** – Describe the fundamentals of industrial digitizing – Describe how the new technology can be used for maintenance activities: ▪ IIoT (Industrial Internet of Things) ▪ eMaintenance ▪ Digital Twins ▪ AI (Artificial Intelligence) ▪ Machine learning – Describe how maintenance will change due to the new technologies	**A maintenance manager should be able to:** – Implement tools for maintenance within Industry 4.0	**A maintenance manager should be able to:** – Implement new techniques and methods in maintenance
3.5.6 Benchmarking	**A maintenance manager should be able to:** – Describe bench marking and various ways to perform – Describe best practice	**A maintenance manager should be able to:** – Perform a bench marking	**A maintenance manager should be able to:** – Spread the knowledge of advantage of benchmarking and support the use
3.5.7 Future maintenance needs	**A maintenance manager should be able to:** – Describe how to define and assure the future maintenance needs of a company – Describe which factors that are important for the need of maintenance activities and how they might be changed in the future (e.g. new requirements regarding goals, strategies and results) – Describe the future needs of maintenance and its influence on the actual activities in the long run (e.g. workload, type of work, quality and quantity)	**A maintenance manager should be able to:** – Define and estimate the future maintenance needs – Prioritize improvements for future investments (EN 17007:2017 OPT.7)	**A maintenance manager should be able to:** – Use methods to improve coming maintenance including calculating investments and implement planned maintenance

	– Describe different future scenarios – The importance for maintenance of taking part in the development phase – Describe how the maintenance experience can be used during the design phase		

References

EN 17007:2017-MAN.7 – Define policy and strategy areas of improvement:

- All information (technical, organizational, economic and social) is analysed to continuously adjust and improve the maintenance policy and strategy.

EN 17007:2017-IMP – Improve the items:

- The purpose of this process is to define, monitor or realize and validate improvements of the item when improvement is a better solution than preventive or corrective actions to manage failures or their consequences. The item is improved in terms of reliability and/or maintainability and/or safety at a convenient cost. It defines the initial reliability, maintainability and maintenance support requirements. Initial maintenance plans, the maintenance providers' related skills and the various logistical resources (hardware, documentation, spare parts, etc.) needed to implement the maintenance plan on the improved item are also defined.

EN 17007:2017-OPT – Improve the results:

- This process represents a part of continuous improvement loop which analyses the internal and external feedback data to determine actions to be taken, targets to be achieved and best practices to be applied for each of the processes.

4. Health, Safety & Environment in maintenance

4.1. Health, Safety & Environment

Overview

- Very good knowledge in health, safety and environment in maintenance
- Legislation, technical standards (EN 15628:2014 C.4:d)
- Safety and health management system (EN 15628:2014 C.4:b)
- Basic methods and techniques of health and safety (EN 15628:2014 C.5:h)
- Ensure compliance with legislation, technical standards and company procedures on safety, health, and environmental protection (EN 15628:2014 C.4:e)
- Ensure that maintenance tasks meet or improve the safety conditions of the asset and the service levels (EN 15628:2014 C.4:f)

Subject	Knowledge	Skills	Responsibility and autonomy
4.1.1 Risk assessment	**A maintenance manager should be able to:** – Describe different conditions in the production equipment that may cause risks for health, safety, and the environment (inside and outside the company) – Explain the possibility to prevent incidents by maintenance activities, including co-operation with other departments in the company and external parties	**A maintenance manager should be able to:** – Plan the work in relation to the health and safety and the right environment conditions according to the processes: ▪ Prepare a carry out risk assessment (EN 17007:2017 HSE.1) ▪ Identify risks (EN 17007:2017 HSE.2) ▪ Prioritize risks (EN 17007:2017 HSE.3) ▪ Propose and carry out measures for preventing risks and consequences of identified risks (EN 17007:2017 HSE.4) ▪ Monitor risk management (EN 17007:2017 HSE.5)	**A maintenance manager should be able to:** – Understand various types of risks and identify which risks that can be reduced or eliminated by proactive activities
4.1.2 Safety and environment protection equipment	**A maintenance manager should be able to:** – Describe what safety equipment is needed to perform maintenance tasks – Mention individual and collective protective equipment	**A maintenance manager should be able to:** – Assure that the maintenance personnel are familiar with and uses necessary safety and environment protection equipment	**A maintenance manager should be able to:** – Carry out correct balance between risks and measures in machine lines and processes and form active measures

	– Mention environmental protection equipment		
4.1.3 Relations with auditing and safety organizations	**A maintenance manager should be able to:** – Describe which national auditing and safety organizations there are – Explain what information auditing and safety organizations require	**A maintenance manager should be able to:** – Discuss HSE issues with auditing and safety organizations for development	**A maintenance manager should be able to:** – Handle guidelines in official documents and own requirements and from that form active measures
4.1.4 Human error analysis	**A maintenance manager should be able to:** – Describe human error analysis – Explain different types of human errors and risks connected to these	**A maintenance manager should be able to:** – Perform human risk analysis – Implementing and keep daily systems for analysing human risks before a task will start	**A maintenance manager should be able to:** – Develop active measures to minimize human errors based on individual reports
4.1.5 Laws and regulations	**A maintenance manager should be able to:** – Describe laws and regulations regarding health, safety, liability, environment, energy, etc. – Describe different methods to measure the fulfilment of the laws and regulations with respect to labour, liability, environment, energy, etc. – Mention national laws and regulations (technical aspects) – Mention governmental organizations that are responsible for laws and regulations regarding maintenance – Mention organizations that are checking the application of these laws and regulations – Explain laws and regulations that have a direct influence on the maintenance activities	**A maintenance manager should be able to:** – Follow laws and regulations regarding HSE aspects – Follow laws and regulations regarding technical aspects	**A maintenance manager should be able to:** – Handle international and national laws, rules, and regulations in the own organization
4.1.6 Environment	**A maintenance manager should be able to:** – Explain how maintenance actions will affect the environment	**A maintenance manager should be able to:** – Implement and run an environment plan for the maintenance organisation	**A maintenance manager should be able to:**

	− Mention maintenance actions to avoid impact on the environment		− Carry out activities to minimize influences on environment outside the plant and indoors for better conditions

References

EN 17007:2017-HSE – Ensure personal health and safety to individuals and preserve environment in maintenance:

− The purpose of this process is to ensure personal health and safety and protect the items and the environment during maintenance tasks. It therefore entails evaluating the risks related to these tasks and Define measures for preventing and responding to the accidental situations described in the Prevention and Safety Plan.

5. Maintenance Engineering Techniques

5.1. Mechanics

Overview

- Understanding in mechanics
- Ability to discuss mechanical issues with maintenance personnel and / or suppliers

Subject	Knowledge	Skills	Responsibility and autonomy
5.1.1 Mechanics	**A maintenance manager should be able to:** – Explain general mechanics	**A maintenance manager should be able to:** – Discuss general mechanical issues with maintenance personnel and suppliers for developments	**A maintenance manager should be able to:** – Have a basic knowledge in mechanical design to understand used techniques
5.1.2 Mechanical parts and components	**A maintenance manager should be able to:** – Mention basic physical principles for mechanical parts and components	**A maintenance manager should be able to:** – Handle different actual physical principles	
5.1.3 Hydraulics and pneumatics	**A maintenance manager should be able to:** – Mention what is significant with hydraulic system – Mention environmental factors and risks associated with hydraulics – Explain what is significant with pneumatic systems	**A maintenance manager should be able to:** – Discuss hydraulic issues with maintenance personnel and suppliers for development – Discuss maintenance work with pneumatics in advanced automated solutions	**A maintenance manager should be able to:** – Have a basic knowledge in mechanical design to understand basics in hydraulics and pneumatics in automation
5.1.4 Bearings	**A maintenance manager should be able to:** – Mention different types of bearings – Mention factors: friction, vibration, greasing of plain (babies) and rolling bearings	**A maintenance manager should be able to:** – Discuss bearing issues with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Have a basic knowledge in mechanical design to understand various types of bearings
5.1.5 Welding and soldering	**A maintenance manager should be able to:** – Mention different welding techniques	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**

	– Mention the standards, rules and regulations for welding	– Discuss welding techniques with maintenance personnel and suppliers for development	– Have a basic knowledge in mechanical design to understand welding principles and soldering
5.1.6 Vibration	**A maintenance manager should be able to:** – Mention the principles of vibration	**A maintenance manager should be able to:** – Discuss vibration issues with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Have a basic knowledge in mechanical design to understand vibration and resonance
5.1.7 Tribology	**A maintenance manager should be able to:** – Explain the fundamentals of: ▪ Friction ▪ Wear ▪ Lubrication ▪ Different lubrication techniques	**A maintenance manager should be able to:** – Discuss tribology issues with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Have a basic knowledge in mechanical design to understand friction and tribology

References

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5.2. Electrics

Overview

– Good knowledge in general electrics

Ability to discuss electrical issues with maintenance personnel and / or suppliers

Subject	Knowledge	Skills	Responsibility and autonomy
5.2.1 Electrics	**A maintenance manager should be able to:** – Explain general electrics	**A maintenance manager should be able to:** – Discuss general electrical issues with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Have a basic knowledge in electrical design to understand used techniques
5.2.2 Electro techniques	**A maintenance manager should be able to:** – Mention resistant, impedance, currant, voltage and frequents and the relations between these	**A maintenance manager should be able to:** – Discuss electro techniques with maintenance personnel and suppliers for development	

	– Calculate direct current – Mention single-phase and three-phase circuits including areas, currants, voltage, and earthing		
5.2.3 Electrical safety	**A maintenance manager should be able to:** – Mention the risks with high voltage and high currents – Mention different methods for personal protection	**A maintenance manager should be able to:** – Plan electrical work in a safe way	**A maintenance manager should be able to:** – Have a basic knowledge in electrical design to understand general safety regulations
5.2.4 Power distribution	**A maintenance manager should be able to:** – Mention methods for distribution of energy with different voltage, currants, transformers earthing, safety etc.	**A maintenance manager should be able to:** – Follow safety rules and regulations for working in electrical installations	**A maintenance manager should be able to:** – Have a basic knowledge in electrical design to understand used distribution high voltage and distribution principles.

References

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5.3. Automation

Overview

– Good knowledge in automation systems

– Ability to discuss automation issues with maintenance personnel and / or suppliers

Subject	Knowledge	Skills	Responsibility and autonomy
5.3.1 Automation	**A maintenance manager should be able to:** – Describe general automation with different types of structure	**A maintenance manager should be able to:** – Discuss general automation issues with maintenance personnel and suppliers – Understand and handle system and function for improvement of the maintenance process	**A maintenance manager should be able to:** – Have a basic knowledge in automation with principles for design in various levels and IT technology
5.3.2 Programming	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**

	– Mention sequence programming of PLC based on analysing functions and system requirements	– Discuss programming issues with maintenance personnel and suppliers for development	– Have a basic knowledge in how programs can be designed and working together I systems
5.3.3 Electronics	**A maintenance manager should be able to:** – Mention how to handle electronic parts in production equipment	**A maintenance manager should be able to:** – Discuss electronical issues with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Be familiar with electronics parts regarding automation and the vocabulary

References

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5.4. Material technology

Overview

– Good knowledge in material technology

– Ability to discuss material technology issues with maintenance personnel and / or suppliers

Subject	Knowledge	Skills	Responsibility and autonomy
5.4.1 Material technology	**A maintenance manager should be able to:** – Mention different material groups; Steel, copper, aluminium, ceramics, polymers – Mention materials mechanical, chemical, electrical, thermal, optical and magnetic properties – Mention how different materials react to wear, tear, temperature, media etc. – Degradation and corrosion	**A maintenance manager should be able to:** – Discuss material technology with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Have a basic understanding in material technology and use of right material for specific application
5.4.2 Non-destructive Testing	**A maintenance manager should be able to:** – Mention the five most common level 1 NDT methods	**A maintenance manager should be able to:** – Discuss NDT issues with maintenance personnel and suppliers for development for development	**A maintenance manager should be able to:** – Know how to work with the most common NDT methods

5.4.3 Heat treatment	**A maintenance manager should be able to:** – Mention different heat treatment techniques – Mention processes for hardening – Mention what happens in materials when heated	**A maintenance manager should be able to:** – Discuss heat treatment techniques with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** – Know the basic principles for heat treatments

References

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5.5. Design and modification

Overview

– Good knowledge in the requirements for design

– Collaborate in the design of new assets, providing all the information and experience useful to the success of the project (EN 15628:2014 C.4:a)

– Evaluate the availability, reliability, maintainability, supportability and the cost of life cycle of asset (EN 15628:2014 C.4:b)

Subject	Knowledge	Skills	Responsibility and autonomy
5.5.1 Design requirements	**A maintenance manager should be able to:** – Define the general requirements for design – Mention how to formulate design requirements regarding design – Describe the process of the development of design requirements – Mention system design and functions in an equipment	**A maintenance manager should be able to:** – Transfer production requirements into functional requirements (e.g. equipment dependability) and into quantitative and qualitative maintenance requirements (e.g. reliability and maintainability) and optimize the resources according to the processes: ▪ Collect feedback data (EN 17007:2017 MRQ.1) ▪ Perform risk analyses (EN 17007:2017 MRQ.2) ▪ Develop reliability, maintainability and logistic support requirements (EN 17007:2017 MRQ.3) ▪ Oversee or contribute to the drafting of specifications (EN 17007:2017 MRQ.4)	**A maintenance engineer should be able to:** – Maintain the platform for progress for the company based on a solid design understanding in: ▪ Production requirement ▪ Maintenance plan ▪ Facility plan ▪ Future requirements

		▪ Issue an invitation to tender to suppliers (EN 17007:2017 MRQ.5) ▪ Participate in the analysis and choice of options and validate the solutions (EN 17007:2017 MRQ.6) ▪ Follow up realization (EN 17007:2017 MRQ.7) ▪ Verify conformity with the reliability, maintainability and logistic support requirements (EN 17007:2017 MRQ.8) ▪ Establish the initial maintenance plan (EN 17007:2017 MRQ.9) ▪ Determine the initial logistical resources (EN 17007:2017 MRQ.10) ▪ Identify skills and training needs (EN 17007:2017 MRQ.11)	
5.5.2 LCC/LCP techniques/methods	**A maintenance manager should be able to:** − Describe the methods of LCC/LCP, and when they can be used − Describe how to organize the work when using the concepts of LCC/LCP − Define how the concepts of LCC/LCP can be used in different situations − Specify the LCC requirements in a procurement process	**A maintenance manager should be able to:** − Use the LCC/LCP method to motivate the best purchase of an item or a system − Make fundamental calculations of LCC/LCP for investments and lifetime decisions − Verify the LCC values and make relevant decisions about the consequences if the verified result is not in accordance with the specified requirements	**A maintenance manager should be able to:** − Calculate and follow up LCC and LCP in the company
5.5.3 Modification	**A maintenance manager should be able to:** − Describe difference between modification and improvement	**A maintenance manager should be able to:** − Discuss modification and improvement with production	**A maintenance manager should be able to:** − Active improve modification with the goal to minimise problem and improve production

References

EN 17007:2017-MRQ – Deliver maintenance requirements during items design and modification:

- The purpose of this process is to define, monitor or realize and validate item investments, modifications and when the operational objectives are no longer reachable or have been changed. It defines the initial reliability, maintainability and maintenance support requirements, maintenance plans, the maintenance providers' related skills and the various logistical resources (hardware, documentation, spare parts, etc.) needed to implement the maintenance plan on these items.

5.6. Facility maintenance

Overview

- Understanding in facility maintenance
- Ability to plan for facility maintenance tasks

Subject	Knowledge	Skills	Responsibility and autonomy
5.6.1 Maintenance services for buildings	**A maintenance manager should be able to:** - Mention ventilation, heating, sewage, water, gas installations etc.	**A maintenance manager should be able to:** - Discuss facility maintenance with maintenance personnel and suppliers for development	**A maintenance manager should be able to:** - Have an understanding in the estate design

References

EN 15331:2011 – Criteria for design, management and control of maintenance services for buildings:

- This European Standard specifies the criteria and the general methods that can be used in the planning, management and control of maintenance in buildings and their surrounding area according to the applicable legal requirements, objectives of the owners and users and the required quality of maintenance.

6. Maintenance Support

6.1. Documentation

Overview

- Good knowledge in documentation handling
- Ability to plan for documentation management
- Define a structured system for plant documentation, assign responsibilities and make sure that all relevant documentation is kept up to date (EN 15628:2014 C.2:e)
- Maintenance manuals (EN 15628:2014 C.6:d)

Subject	Knowledge	Skills	Responsibility and autonomy
6.1.1 Maintenance documents	**A maintenance manager should be able to:** - Explain which documents are needed to perform the maintenance tasks, including, work order, technical instructions, maintenance procedures, list of necessary resources, maintenance plans, time schedules, maintenance records and any other document needed to perform maintenance - Explain common systems for managing documentation	**A maintenance manager should be able to:** - Develop and use the documentation according to the processes: ▪ Define and manage rights to the documentation (EN 17007:2017 DOC.1) ▪ Classify and structure the documentation (EN 17007:2017 DOC.2) ▪ Compile (collect, create) and update the reference documentation (EN 17007:2017 DOC.3) ▪ Always ensure access to necessary information (EN 17007:2017 DOC.4)	**A maintenance manager should be able to:** - Plan for the management of maintenance document including validity and actuality
6.1.2 Technical documentation and maintenance manuals	**A maintenance manager should be able to:** - Explain different types of technical documentation and maintenance manuals	**A maintenance manager should be able to:** - Read and understand electrical, mechanical pneumatic, electronic, hydraulic schemes, building drawings and maintenance manuals	**A maintenance manager should be able to:** - Manage and organize that the staff can read and understand different standards in maintenance document
6.1.3 Documentation systems	**A maintenance manager should be able to:** - Explain methods and relevant tools for systemizing the documentation	**A maintenance manager should be able to:** - Manage the way in which operational documentation is made available (EN 17007:2017 DOC.5)	**A maintenance manager should be able to:** - Organize a proper handling system for maintenance documentation

		– Maintain and/or update the maintenance documentation system to ensure that all documentation is up to date	

References

EN 17007:2017-DOC – Deliver the operational documentation:

– To provide all those concerned, at the place of use, with all the up-to-date and usable documents they need to prepare for and perform the tasks for which they are responsible while optimizing logistic times.

6.2. Information and data management

Overview

– Good knowledge in information and data management
– Ability to manage information and data
– Maintenance information systems, technological tools and innovations (EN 15628:2014 C.2:e)
– Legislation, technical standards (EN 15628:2014 C.2:f)
– Fundamentals and tools of management control (EN 15628:2014 C.4:e)
– Maintenance information systems and tools (EN 15628:2014 C.5:c)
– Ensure the proper and timely use of maintenance information systems, promoting the upgrade the development of systems and tools necessary to meet the business requirements (EN 15628:2014 C.2:b)
– Define criteria for the development and implementation of diagnostic systems (EN 15628:2014 C.2:c)
– Ensure the proper right and timely use of maintenance information systems, promoting the upgrade and the development of systems and tools necessary to make them consistent with the technical and management needs (EN 15628:2014 C.5:e)

Subject	Knowledge	Skills	Responsibility and autonomy
6.2.1 Maintenance information systems	**A maintenance manager should be able to:** – Explain common types of information systems and how they are combined (e.g. the customer requirements on maintenance, the efficiency of the plant equipment and the machinery, the different contracts for the maintenance performance)) – Explain common Maintenance Information Systems (for planning, work order,	**A maintenance manager should be able to:** – Define, develop and implement Maintenance Information Systems	**A maintenance manager should be able to:** – Use a maintenance information system including CMMS system if such system is in use.

	technical/economical analysis, and so on) and different modules in CMMS – Explain different types of information for maintenance activities (e.g. workorder, work control, planning, work preparation, spare parts, LCC/LCP, safety, risks, environment, production results, betterment, modifications, investments, etc) – Explain requirements for information systems that will handle maintenance activities		
6.2.2 Information handling systems	**A maintenance manager should be able to:** – Explain how to use the information handling systems for maintenance tasks – Explain how different standards of documents shall look like (e.g. maintenance instructions, equipment lists, drawings, spare part lists, education/personnel information, handbooks, etc.) – Explain how different ideas regarding Information handling systems (e.g. paper computerized, local central, advantages disadvantages, etc.) shall be handled	**A maintenance manager should be able to:** – Organize and carry out the work to keep the information handling systems updated	**A maintenance engineer should be able to:** – Use an information handling system including a CMMS system if such system is in use
6.2.3 Maintenance data collection	**A maintenance manager should be able to:** Explain how to collect maintenance data – Explain common data management systems – Explain how to use the data management systems for maintenance tasks – Explain fundamental requirements regarding the security for data management and the need of backup for computer systems	**A maintenance manager should be able to:** – Develop, use and update the data in the systems according to the processes: ▪ Store and validate the raw data in a library and/or a database (EN 17007:2017 DTA.1) ▪ Evaluate the reliability and maintainability of the items by maintaining an actual state assessment of the items (EN 17007:2017 DTA.2) ▪ Draw up and maintain an up-to-date list of critical items (EN 17007:2017 DTA.3)	**A maintenance manager should be able to:** – Collect develop and run Maintenance information system including CMMS system if such system is in use.

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6.2.4 Data evaluation	**A maintenance manager should be able to:** – Explain techniques for data evaluation for maintenance processes	**A maintenance manager should be able to:** – Evaluate the data in the systems according to the processes: ▪ Evaluate and analyse maintenance data and HSE data (EN 17007:2017 DTA.4) ▪ Evaluate and analyse data related to spare parts (EN 17007:2017 DTA.5) ▪ Evaluate and analyse cases of known or predictable obsolescence (EN 17007:2017 DTA.6) ▪ Collect and analyse events at other organizations (EN 17007:2017 DTA.7) ▪ Compare maintenance practices and materials used by other operators or recommended by suppliers (EN 17007:2017 DTA.8)	**A maintenance manager should be able to:** – Develop and run Maintenance data system including CMMS system if such system is in use.
6.2.5 Data monitoring	**A maintenance manager should be able to:** – Explain techniques for data monitoring of maintenance processes	**A maintenance manager should be able to:** – Develop, use and present the data in the systems according to the processes: ▪ Monitor methods, technologies, regulations, standards, etc. (EN 17007:2017 DTA.9) ▪ Save and provide access to data in a data processing system (EN 17007:2017 DTA.10 ▪ Calculate, save, and provide access to performance and monitoring indicators (EN 17007:2017 DTA.11)	**A maintenance manager should be able to:** – Process data from the production with the goal to improve the maintenance
6.2.6 Computerized Maintenance Management Systems (CMMS)	**A maintenance manager should be able to:** – Explain the different structures in a CMMS – Explain how to use the CMMS for maintenance tasks	**A maintenance manager should be able to:** – Select, develop and implement a CMMS system that is suitable for the maintenance department	**A maintenance manager should be able to:** – Manage and develop existing CMMS including proper use in the organization

	– Explain principle concept how to handle a project regarding the implementation of a new CMMS (e.g. the choice of system, preparation, installation, training)	– Promote and carry out routines for the use of the CMMS throughout the company´s organisation	
6.2.7 Technical process control systems	**A maintenance manager should be able to:** – Explain common technical process control systems and limits and uncertainties that might exist in these systems – Explain the relationship between the process control system and the maintenance information system – Explain common types and the principle of an expert system	**A maintenance manager should be able to:** – Select, develop and implement technical process control systems that are suitable for the items and systems to be maintained	**A maintenance manager should be able to:** – Manage and develop existing various technical PC and PLC process control system including proper use in the organization

References

EN 17007:2017-MAN.6 – Define, select, analyse and communicate the information:

– The technical, organizational, economic and social information that shall be communicated internally and/or externally is defined, selected, analysed and made available to the relevant entities.

EN 17007:2017-DTA – Manage data:

– Collect, analyse, store and transmit all data needed to document and im-prove the maintenance process..

6.3. Resource management

Overview

– Very good knowledge in needed recourses regarding infrastructures, Human Resources, external maintenance services and material, tools and equipment
– Ability to manage resources
– Procedures (EN 15628:2014 C.2:g)
– Principles, logic and parameters of operation and utilization of asset and item (EN 15628:2014 C.2:h)
– Human resources selection policies (EN 15628:2014 C.3:c)
– Principles, logic and parameters of operation and utilization of asset and item (EN 15628:2014 C.4:f)
– Materials logistics (EN 15628:2014 C.7:b)
– Methods and policies for the management of materials and warehouses (EN 15628:2014 C.7:c)
– Ensure that maintenance tasks meet or improve the safety conditions of the asset and the service levels (EN 15628:2014 C.5:c)

- Promote the use of professional skills and technical resources available (EN 15628:2014 C.5:f)
- Coordinate staff and employees, promoting the synergistic integration of tasks of available resources (EN 15628:2014 C.5:g)
- Collaborate in the definition of strategies for the supply of maintenance services on the basis of technical requirements and business objectives (EN 15628:2014 C.7:c)

Subject	Knowledge	Skills	Responsibility and autonomy
6.3.1 Infrastructure	**A maintenance manager should be able to:** - Explain needed infrastructural recourses; appropriate and safe premises and areas, necessary power, utilities, and services for maintenance	**A maintenance manager should be able to:** - Define and plan needed resources according to the processes: ▪ Plan and provide appropriate and safe premises and areas (EN 17007:2017 IST.1) ▪ Plan and provide the necessary power, utilities, and services (EN 17007:2017 IST.2) ▪ Maintain and/or update the infrastructures and facilities (EN 17007:2017 IST.3)	**A maintenance manager should be able to:** - Handle the total structure for support of roads, transports, electrical power, water, trash, and outlets
6.3.2 Human resources	**A maintenance manager should be able to:** - Explain needed Human Resources to carry out planning and scheduling including, planning for training of personnel, lifelong learning, contacts between operation and maintenance, work scheduling, work execution and reporting - Explain how to develop and optimize the Human Resources, their location, quality and quantity - Explain why a Human Resource policy must be set up and what the fundamental requirements are for such a policy - Describe an example of a Human Resources development policy and how it is developed	**A maintenance manager should be able to:** - Define, plan and provide internal human recourses for the maintenance organization according to the processes: ▪ Manage jobs and skills (EN 17007:2017 RES.1) ▪ Recruit competent staff (EN 17007:2017 RES.2) ▪ Ensure training, qualification, and certification of internal staff (EN 17007:2017 RES.3) ▪ Provide internal Human Resources (EN 17007:2017 RES.4) - Define and implement a Human Resource policy for maintenance	**A maintenance manager should be able to:** - Manage the manpower including recruiting, improvements of work and handling physical and drug problem

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6.3.3 External maintenance services	**A maintenance manager should be able to:** – Explain the needed external maintenance services to carry out planning and scheduling including, contacts between external and internal maintenance personnel, work scheduling, work execution and reporting – Explain how to balance external support in respect of own resources – Explain how to develop and optimize the external maintenance services and their quality and quantity including the importance of reporting the work	**A maintenance manager should be able to:** – Define and plan the external maintenance services and their quality and quantity according to the processes: ▪ Identify competent external companies (EN 17007:2017 SER.1) ▪ Contract with external companies (EN 17007:2017 SER.2) ▪ Manage contracts and evaluate companies and services (EN 17007:2017 SER.3) ▪ Provide external services (EN 17007:2017 SER.4)	**A maintenance manager should be able to:** – Manage how to optimize external resources as apart of total maintenance in the company. These activities include reporting activities and in cooperation in CMMS system
6.3.4 Material, tools and equipment	**A maintenance manager should be able to:** – Explain needed equipment to perform maintenance tasks; material, tools, measuring and control equipment, computer equipment, handling equipment (slings, fork-lift trucks, hoists, etc.), means of access (scaffolding, ladders, platforms, etc.) – Explain common requirements for handling materials, tools and equipment – Explain how to develop and optimize material, tools and equipment and their location, quality and quantity	**A maintenance manager should be able to:** – Plan the supply of the material, tools and equipment and their location, quality and quantity according to the processes: ▪ Determine and provide the support equipment needed for maintenance (EN 17007:2017 TOL.1) ▪ Store the support tools and equipment (EN 17007:2017 TOL.2) ▪ Maintain and/or Update the support equipment (EN 17007:2017 TOL.3) ▪ Deliver the tools and other support equipment (EN 17007:2017 TOL.4) ▪ Determine and provide a maintenance management, decision support software tools and documentation system (EN 17007:2017 TOL.5) ▪ Maintain and/or update the maintenance documentation system (EN 17007:2017 TOL.6)	**A maintenance manager should be able to:** – Plan basic material, tools, and equipment for maintenance

6.3.5 Remote maintenance	**A maintenance manager should be able to:** – Explain common remote maintenance methods	**A maintenance manager should be able to:** – Plan and carry out for remote maintenance	**A maintenance manager should be able to:** – Plan maintenance outside own plant
6.3.6 Contracting, outsourcing and insourcing	**A maintenance manager should be able to:** – Explain ways of contracting, outsourcing and insourcing maintenance resources – Explain common models and standards for contracting – Mention the pros and cons of outsourcing maintenance	**A maintenance manager should be able to:** – Decide when and where contracting, outsourcing and insourcing is most effective in the maintenance organization – Develop and/or use relevant documents for contracting, outsourcing and insourcing maintenance resources	**A maintenance manager should be able to:** – Handle legal aspects round own and supporting maintenance resources

References

EN 17007:2017-IST – Provide the needed infrastructures:

- Provide the infrastructures and facilities that all maintenance personnel need to fully perform their tasks in a manner that is safe for the individuals, the items and the environment.

EN 17007:2017-RES – Provide internal Human Resources:

- Provide in a timely manner the internal Human Resources who have the necessary skill levels and certification to perform the maintenance activities.

EN 17007:2017-SER – Provide external maintenance services:

- Provide in a timely manner the maintenance services carried out by external companies who have the necessary skill levels and certification to perform the maintenance activities.

EN 17007:2017-TOL – Deliver the tools, support equipment and information system:

- Provide users with the operational technical resources needed for maintenance (conventional and specialized tools, test, handling and other equipment, and information and maintenance management systems)

6.4. Spare parts management

Overview

- Very good knowledge in maintenance logistics
- Ability to manage spare parts
- Provide guidelines for the definition of necessary spare parts and equipment to ensure the availability and according to the business requirements (EN 15628:2014 C.7:d)

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Subject	Knowledge	Skills	Responsibility and autonomy
6.4.1 Spare parts management	**A maintenance manager should be able to:** – Describe the key factors regarding spare parts management	**A maintenance manager should be able to:** – Carry out and implement an effective spare parts management	**A maintenance manager should be able to:** – Manage spare part handling and routines for purchase and delivery adapted for planned maintenance
6.4.2 Spare part calculations	**A maintenance manager should be able to:** – Explain common methods for spare parts calculations, e.g. Wilson formula, ABC-analysis – Explain how to calculate the total amount of spare parts and how many of each type, inclusive the typical mathematical formulas for this purpose	**A maintenance manager should be able to:** – Determine the spare items to keep in stock for maintenance (EN 17007:2017 SPP.1)	**A maintenance manager should be able to:** – Calculate best stock of spare parts in relation to the needs and eventually emergency situations
6.4.3 Material and store handling	**A maintenance manager should be able to:** – Describe different ways of organizing the spare part store (e.g., centralized, decentralized, at the supplier)	**A maintenance manager should be able to:** – Manage stocks for an efficient maintenance (EN 17007:2017 SPP.2)	**A maintenance manager should be able to:** – Develop and keep a system for spare stock management
6.4.4 Logistics support	**A maintenance manager should be able to:** – Mention routines and organization for an optimized logistic support (e.g. purchasing, quality control, delivery systems inside the maintenance organization, etc.)	**A maintenance manager should be able to:** – Plan and organize the logistic support of maintenance resources according to the processes: ▪ Reserve or issue a purchase request for spare items (EN 17007:2017 SPP.3) ▪ Order spare items from suppliers (EN 17007:2017 SPP.4) ▪ Establish and monitor contracts with suppliers (EN 17007:2017 SPP.5)	– Develop and keep a total system for handling spare parts in the store including quality and meeting ageing problem
6.4.5 Spare part handling	**A maintenance manager should be able to:** – Explain the different factors that will have an influence on an optimized organisation of the spare part consumption (e.g. cost for lack of	**A maintenance manager should be able to:** – Plan and organize for an efficient spare part handling according to the processes:	**A maintenance manager should be able to:** – Plan, organize and administrate a spare part store

	spare parts, cost for storage, cost for interest, etc.)	▪ Receive ordered or repaired spare items (EN 17007:2017 SPP.6) ▪ Add the spare items to stock (EN 17007:2017 SPP.7) ▪ Perform preventive maintenance on spare items in stock (EN 17007:2017 SPP.8) ▪ Deliver spare items (EN 17007:2017 SPP.9) ▪ Assess replaced items (EN 17007:2017 SPP.10) ▪ Repair replaced items (EN 17007:2017 SPP.11) ▪ Dispose faulty or damaged items (EN 17007:2017 SPP.12)	

References

EN 17007:2017-SPP – Deliver spare parts:

- Provide the maintenance teams with the spare parts and, more generally, all spare items (spare parts, consumables, materials, etc.) needed for the maintenance actions within the required timeframes.

6.5. Procurement

Overview

- Very good knowledge in procurement of maintenance parts and services
- Remuneration policies (EN 15628:2014 C.3:e)
- Procurement policies (EN 15628:2014 C.7:a)
- Contractual models and standards (EN 15628:2014 C.7:d)
- Legislation and technical standards (EN 15628:2014 C.7:e)
- Procedures (EN 15628:2014 C.7:f)
- Purchasing requirements (EN 15628:2014 C.7:g)
- Manage maintenance contracts in relation to legislation, technical standards and business practices and verify the contractors effectiveness and efficiency (EN 15628:2014 C.7:b)

Subject	Knowledge	Skills	Responsibility and autonomy
6.5.1 Procurement	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**	**A maintenance manager should be able to:**

	– Explain the different steps in procurement of maintenance recourses – Explain the influence of maintenance in the procurement – Explain procedures regarding procurement including technical specifications	– Discuss and make decisions regarding procurement issues with the procurement department	– Handle the legal aspects of procurement including technical specifications
6.5.2 Replacement investments	**A maintenance manager should be able to:** – Describe company rules for replacement investments	**A maintenance manager should be able to:** – In cooperation with production, advise when to invest in replacements	

References

EN 13269:2016 – Guideline on preparation of maintenance contracts:

– This European Standard provides guidance on the preparation of private contracts for maintenance services.

6.6. Risk based maintenance

Overview

– Very good knowledge in Risk Based Maintenance

– Ability to use risk assessment in maintenance prepare the risk assessment, identify risks, prioritize risks, propose measures for preventing risks and consequences of identified risks and monitor risk management

Subject	Knowledge	Skills	Responsibility and autonomy
6.6.1 Risk assessment in maintenance	**A maintenance manager should be able to:** – Explain common risks and how it is defined – Explain common steps in general risk analysis – Explain common technical and human related risks and how to handle them	**A maintenance manager should be able to:** – Calculate and prevent risks within maintenance – Judge the quality on performed risk analysis – Analyse and prevent dangerous situations.	**A maintenance manager should be able to:** – Manage risks related to production and to maintenance.
6.6.2 Methods for risk analysis	**A maintenance manager should be able to:**	**A maintenance manager should be able to:** – Apply and carry out different methods for risk analysis	**A maintenance manager should be able to:** – Handle existing methods on the market and implement best methods

	− Explain common methods for risk analysis and when they can be used (e.g. FMEA, RCM, Criticality Analysis, Fault-tree) − Explain the different steps in a Reliability Centred Maintenance (RCM) − Explain the different steps in a Criticality Analysis		
6.6.3 Monitor risk management	**A maintenance manager should be able to:** − Explain common methods for risk monitoring	**A maintenance manager should be able to:** − Plan and perform risk monitoring	**A maintenance manager should be able to:** − Handle accrued incidents.

References

EN 16991:2018 – Risk-based inspection framework:

− This European Standard specifies the Risk-Based Inspection Framework (RBIF) and gives guidelines for Risk-Based Inspection and Maintenance (RBIM).

7. Basic knowledge

7.1. Maintenance terminology

Overview

- Very good knowledge in maintenance terminology
- Ability to use the proper terminology when discussing maintenance with maintenance personnel, production, and suppliers

Subject	Knowledge	Skills	Responsibility and autonomy
7.1.1 General terminology	**A maintenance engineer should be able to:** – Describe general maintenance terminology	**A maintenance engineer should be able to:** – Use proper general terminology when discussing maintenance with maintenance personnel, production, and suppliers	**A maintenance engineer should be able to:** – Understand and correct use common technical words and concepts.
7.1.2 Availability	**A maintenance engineer should be able to:** – Describe how reliability has to do with the time of the ready state for the equipment – Describe the definition of availability – Describe the connection and differences between dependability, availability, reliability, maintainability, and supportability – Describe the measure of availability – Describe the influence of availability on the production – Describe different ways to improve the availability	**A maintenance engineer should be able to:** – Use the proper terminology when discussing availability with maintenance personnel, production, and suppliers – Calculate the availability with respect to down time, running time, operational cycles, production, calendar time, etc. – Analyse what causes low availability	**A maintenance engineer should be able to:** – Understand how the availability affects the production process including calculation, vocabulary, and concepts
7.1.3 Reliability	**A maintenance engineer should be able to:** – Describe how reliability has to do with the number of failures and the disabled states due to maintenance activities – Describe the definition of reliability	**A maintenance engineer should be able to:** – Use the proper terminology when discussing reliability with maintenance personnel, production, and suppliers	**A maintenance engineer should be able to:** – Understand how the reliability affects the production process including calculation, vocabulary, and concepts

	– Describe different measures of reliability (MTBF and MTTF) – Describe different types of redundancies – Describe different ways to improve the reliability (e.g. the choice of components, redundancies, design, preventive maintenance, better operational use)	– Calculate the reliability probability for single, serial, and parallel system and for active and passive redundancies	
7.1.4 Maintainability	**A maintenance engineer should be able to:** – Describe how reliability has to do with active time for maintenance – Describe the definition of maintainability – Describe different measures of maintainability (MRT and M) – Describe different ways to improve the maintainability (e.g. design, documentation, maintenance equipment, education) – Describe which time elements that are included or not included in the calculation (e.g. preparation time, functional check out, waiting for resources)	**A maintenance engineer should be able to:** – Use the proper terminology when discussing maintainability with maintenance personnel, production, and suppliers – Calculate the maintainability and analyse what causes the length of active maintenance times	**A maintenance engineer should be able to:** Understand how the maintainability affects the production process including calculation, vocabulary, and concepts
7.1.5 Maintenance Supportability	**A maintenance engineer should be able to:** – Describe how reliability has to do with waiting times for maintenance resources – Describe the definition of supportability – Describe the measure of supportability (MWT) – Describe different ways to improve the supportability (e.g. assure faster access of personnel, documentation, spare parts, maintenance equipment, transports and assure faster administrative routines)	**A maintenance engineer should be able to:** – Use the proper terminology when discussing supportability with maintenance personnel, production, and suppliers – Calculating supportability and analyse what causes the length of the waiting times	**A maintenance engineer should be able to:** Understand how the maintenance supportability affects the production process including calculation, vocabulary, and concepts

References

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EN 13306:2017 – Maintenance terminology:

- This European Standard specifies generic terms and definitions for the technical, administrative and managerial areas of maintenance.

7.2. Basics in mathematics, physics and chemistry

Overview

- Good knowledge in mathematics, physics, and chemistry
- Ability to use the basics in mathematics, physics, and chemistry

Subject	Knowledge	Skills	Responsibility and autonomy
7.2.1 Mathematics	**A maintenance engineer should be able to:** – Describe basic academical and practical mathematics	**A maintenance engineer should be able to:** – Use the basics in mathematic calculations	**A maintenance practician should be able to:** – Use mathematics, physics, chemistry, and statistics in daily work
7.2.2 Physics	**A maintenance engineer should be able to:** – Describe basic academical and practical physics	**A maintenance engineer should be able to:** – Use the basics in physics applications	
7.2.3 Chemistry	**A maintenance engineer should be able to:** – Describe basic academical and practical chemistry	**A maintenance engineer should be able to:** – Use the basics in chemistry applications	
7.2.4 Statistical methods	**A maintenance engineer should be able to:** – Describe common statistical methods	**A maintenance engineer should be able to:** – Use the common statistical methods for analysis	

References

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7.3. Maintenance standards

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Overview

- Understanding in European standards within maintenance

Subject	Knowledge	Skills	Responsibility and autonomy
7.3.1 EN 13269:2016 Guideline on preparation of maintenance contracts	**A maintenance engineer should be able to:** - Mention the standard EN 13269:2016 Guideline on preparation of maintenance contracts	**A maintenance engineer should be able to:** - Use the standard EN 13269:2016 Guideline on preparation of maintenance contracts	**A maintenance engineer should be able to:** - Use the standard in normal work including vocabulary and concepts
7.3.2 EN 13306:2017 Maintenance Terminology	**A maintenance engineer should be able to:** - Mention the standard EN 13306:2017 Maintenance Terminology	**A maintenance engineer should be able to:** - Use the standard EN 13306:2017 Maintenance Terminology	
7.3.3 EN 13460:2009 Maintenance Documentation	**A maintenance engineer should be able to:** - Mention the standard EN 13460:2009 Maintenance Documentation	**A maintenance engineer should be able to:** - Use the standard EN 13460:2009 Maintenance Documentation	
7.3.4 EN 15331:2011 Criteria for design, management and control of maintenance services for buildings	**A maintenance engineer should be able to:** - Mention the standard EN 15331:2011 Criteria for design, management, and control of maintenance services for buildings	**A maintenance engineer should be able to:** - Use the standard EN 15331:2011 Criteria for design, management, and control of maintenance services for buildings	
7.3.5 EN 15341:2019 Maintenance Key Performance Indicators	**A maintenance engineer should be able to:** - Mention the standard EN 15341:2019 Maintenance Key Performance Indicators	**A maintenance engineer should be able to:** - Use the standard EN 15341:2019 Maintenance Key Performance Indicators	

7.3.6 EN 15628:2014 Qualifications of maintenance personnel	**A maintenance engineer should be able to:** – Mention the standard EN 15628:2014 Qualifications of maintenance personnel	**A maintenance engineer should be able to:** – Use the standard EN 15628:2014 Qualifications of maintenance personnel	
7.3.7 EN 16646:2014 Maintenance within physical asset management	**A maintenance engineer should be able to:** – Mention the standard EN 16646:2014 Maintenance within physical asset management	**A maintenance engineer should be able to:** – Use the standard EN 16646:2014 Maintenance within physical asset management	
7.3.8 EN 16991:2018 Risk-based inspection framework	**A maintenance engineer should be able to:** – Mention the standard EN 16991:2018 Risk-based inspection framework	**A maintenance engineer should be able to:** – Use the standard EN 16991:2018 Risk-based inspection framework	
7.3.9 EN 17007:2017 Maintenance process and associated indicators	**A maintenance engineer should be able to:** – Mention the standard EN 17007:2017Maintenance process and associated indicators	**A maintenance engineer should be able to:** – Use the standard EN 17007:2017Maintenance process and associated indicators	

References

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7.4. Technical English

Overview

– Very good knowledge in technical English

– English language including technical English (EN 15628:2014 C.5:g)

Subject	Knowledge	Skills	Responsibility and autonomy
7.4.1 Maintenance technical English	**A maintenance engineer should be able to:**	**A maintenance engineer should be able to:**	**A maintenance engineer should be able to:** – Read and understand technical documents

	− Describe the basics in English maintenance vocabulary − Explain maintenance terms in the English language	− Understand and apply technical text and maintenance terms in English	

References

− Language test in English is adapted for test takers which have other mother tongue than English.