

EFNMS



The European Federation of National Maintenance Societies

The Requirements and Rules to achieve a Certificate as a European Expert in Maintenance Management

Background

To become competent to manage and develop the maintenance activities and to run a modern costeffective maintenance organization, there are several areas of knowledge that have to be assimilated.

The European Federation of National Maintenance Societies, EFNMS, has developed a specification for the minimum requirements of knowledge for an Expert in Maintenance Management.

The EFNMS will also certify those individuals in Europe that can prove they have enough competence (to have the required theoretical knowledge and practical experience) to become a Certified European Expert in Maintenance Management.

The aim has been to specify the theoretical knowledge and the practical experience to be held by a maintenance manager, thereby assuring that the maintenance activities can be organized and performed in the best possible way in each company.

The objective is a competence assurance of the maintenance activities within Europe.

This document includes

**the EFNMS minimum Requirements of knowledge for an Expert in
Maintenance Management the Rules to be able to achieve the EFNMS
Certificate as an European Expert in Maintenance Management.**

Any individual or organisation is free to use these requirements as a base for their training programmes.

All individuals have their right to apply for the EFNMS Certificate and to join the examinations of the theoretical knowledge that are arranged by a National Member Society of the EFNMS.

*These requirements and rules were accepted by the EFNMS Council on the 17th of April 1993
and amended by the EFNMS Council on the 30th of May 1998.*

The EFNMS minimum requirements of knowledge for an Expert in Maintenance Management

A general approach

The specification contains the minimum requirements of the theoretical knowledge for a maintenance manager in general. Special requirements for maintenance managers in electrical, mechanical, chemical industries or others, are not covered. However, this specification aims to fulfil the intention to be comprehensive and include the essential and fundamental knowledge, that any expert in maintenance management has to have, regardless in which company or country he is working.

In short the requirements cover the following areas:

Management and organization

- Goal, strategies, results
- Organization, competence
- Procurement, selling of service
- Guiding, control, analysis
- Economical control, LCC, LCP
- Material handling, logistics

Reliability performance of production plants

- Definitions
- Measurements, mathematical formulas
- Requirements, control, analysis
- Design, procurement, operation
- Laws, regulations

Maintenance information systems

- Planning, ordering, analysis
- Documentation
- Information systems
- Technical/economical analysis

Maintenance methods and techniques

- Remote control, condition monitoring
- Preventive activities
- Repair techniques and methods

The required knowledge mentioned above is general for an Expert in Maintenance Management in any European country. To be able to achieve the EFNMS Certificate the requirements also include:

Maintenance terms in the english language

Three levels of knowledge

In the detailed specification the requirements of knowledge has been described in three levels:

Level 1. *Very good knowledge*

For these subjects the requirements are to have a very good knowledge to be able to handle the special tasks that belong to a maintenance manager.

Level 2. *Good Knowledge*

For these subjects the requirements are to have enough knowledge to be able to manage and develop these activities.

Level 3. *Understanding*

For these subjects the requirements are to have enough understanding to be able to make the right decisions and to have an insight of the total implications of the maintenance activities inside and outside a company.

The detailed specification

Note: The information that are given within brackets () are just examples to clarify the ideas behind the requirements in the specification, and shall not be looked upon as a total list, but just as examples. After some of the detailed text there is a sign [GK] or [U]. These signs indicates that the specified detailed knowledge has a requirement equal to *Good Knowledge* respectively *Understanding*.

3.1 Management and Organization

Within this area it is essential to have a very good knowledge about the importance of maintenance for the economy in the company, for the achievements of the production goals and for the quality of the product, and so on. It is important to have good knowledge of the organization of the maintenance activities. Therefore the following knowledge has to be obtained:

Very good knowledge in:

How to set up a company management policy in order to be able to participate in its definitions as far as maintenance is concerned.

- to describe why a policy has to be set up and what the requirements are for a policy
- to give examples in which way the maintenance aspects relate to a company management policy

How to formulate the maintenance policy within a company

- to give an example of a maintenance policy to describe what the requirements for a maintenance policy
- to describe the process of the development of a maintenance policy

How to formulate the maintenance goals.

- to describe the general requirements for maintenance goals
- to describe the process of the development of maintenance goals to give examples of maintenance goals to describe the relationship between goals and policy

Different maintenance strategies and how to choose the right strategy.

- to formulate different maintenance strategies
- to describe the reasons behind the choice of a certain strategy

How to specify the requirements for the maintenance activities.

- to describe the different maintenance activities
- to describe different requirements for the maintenance activities
- to describe the process of the identification, the formulation and the Communication of the requirements

How to organize the maintenance activities, how to choose a suitable organization and assure the right competence within the organization.

- to describe different types of maintenance organizations (e.g. centralized, decentralized, cooperation with the equipment supplier and/or servicing companies and integration with the production)
- to describe the advantages and the disadvantages with the different types of organizations and the combination of them
- to describe how to develop the competence in all the different types of organizations

How to determine the human and material resources in order to implement the organization.

to state the different types of maintenance resources (e.g. tools, material, personnel, transportation, documentation, shops)

to describe how to develop and optimize the maintenance resources (personnel and material), their location, quality and quantity.

How to assure (by maintenance activities) the health and safety and the right environment conditions (inside and outside the company).

to describe different conditions in the production equipment that may cause risks for health, safety and the environment (inside and outside the company)

to describe the possibility to prevent such incidents by maintenance activities, including cooperation with other departments in the company and external parties.

How to guide, control and analyse the maintenance activities.

to 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

to describe different general aspects that have to be taken into account for analysis

to describe the methods and techniques for analysing and the betterment process

to describe different methods to control the maintenance activities

to understand the different maintenance concepts (e.g. TPM, RCM, etc)

How to develop and use key-figures for the economical control.

to describe different types of key-figures (indicators) for maintenance

to describe how to use the key-figures in the control and development of the maintenance activities

to describe what the fundamental requirements are for key-figures

to describe the most useful key-figures for different maintenance organizations

LCC/LCP techniques/methods.

to describe the methods of LCC and LCP, and when they can be used

to be able to make some fundamental calculations of LCC and LCP

to describe how to organize the work when using the concepts of LCC and LCP

to describe how the concepts of LCC and LCP can be used in different situations

to describe how to specify the LCC requirements in a procurement process [GK]

to describe how to verify the LCC values and the consequences if the verified result is not in accordance with the specified requirements [GK]

Logistics support, material and store handling, methods for spare part calculations

to describe the different factors that will have an influence on an optimized organisation of the spare part consumption (e.g. cost for lack of spare parts, cost for storage, cost for interest, etc)

to describe routines and organization for an optimized logistic support of spare parts (e.g. purchasing, quality control, delivery systems inside the maintenance organization, etc)

to describe different ways of organizing the spare part store (e.g. centralized, decentralized, at the supplier)

to describe how to calculate the total amount of spare parts and how many of each type, inclusive the typical mathematical formulas for this purpose [GK]

How to measure and analyse the results of the maintenance activities, e.g. efficiency and economy.

to describe different methods to measure the result of the maintenance activities, the advantages and disadvantages with the methods and their handling of the economical aspects

to describe what is not covered by these methods

to understand different economical models regarding maintenance and understand the fundamental principles regarding the economical results for a company

to be able to develop a model for measurement and analysis of the maintenance activities.

The maintenance activities in the development and procurement of new production equipment.

to 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

to understand the importance for maintenance of taking part in the development phase

to describe how the maintenance experience can be used during the design phase

How to define the future maintenance needs of a company.

to understand 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)

to understand the future needs of maintenance and its influence on the actual activities in the long run (e.g. work load, type of work, quality and quantity)

to be able to describe different future scenarios.

Good Knowledge in:

How to define and implement human resources development policy.

to describe why a human resources development policy has to be set up and what the fundamental requirements are for such a policy

to give an example of a human resources development policy

to describe the process of the development of a human resources development policy.

Understanding in:

Actual European standards within maintenance.

Laws and regulations regarding labor, liability, guarantee, environment, energy, etc.

to describe different methods to measure the fulfillment of the laws and regulations with respect to labor, liability, guarantee, environment, energy, etc.

to describe what is not covered by these methods

to know the different unions in the country and the agreed commitments

The essential contribution from maintenance activities to achieve good product quality and good production performance.

to understand the maintenance contribution

3.2 Availability Performance of Production plants

Within this area it is essential to have knowledge about how to guide, control and develop the availability performance activities, in order to assure the performance of the production, the quality of the products, the safety regulations and the environment conditions.

It is important to have good knowledge of all availability performance activities that shall be taken care of during the entire life cycle of a production system, e.g. during development, procurement, operation and displacement of a production equipment. Therefore the following knowledge has to be obtained:

Very good knowledge in:

Reliability.

to understand that this has to do with the number of failures and the disabled states due to maintenance activities

to be able to define reliability

to describe some different measures of reliability (e.g. MTBF, MTTF, etc)

to be able to calculate the reliability

to be able to describe the mechanism that causes the failures

to describe the different redundancies [U]

to be able to draw a reliability block diagram with serial and parallel systems and for active and passive redundancies [U]

to be able to calculate the reliability probability for a serial and parallel system and for active and passive redundancies [U] to be aware of the different statistical distributions for failures (e.g. Exponential, Lognormal, Weibull, etc) [U]

Maintainability

to understand that this has to do with active time for maintenance

to be able to define maintainability

to describe some different measures of maintainability (e.g. MTTR, M, etc) to be able to calculate the maintainability to describe which time elements that are included and not included in the calculation (e.g. preparation time, functional check out, waiting for resources) [GK]

to be able to analyse what causes the length of active maintenance times

Supportability

to understand that this has to do with waiting times for maintenance resources

to be able to define supportability

to describe some different measures of supportability (e.g. MLDT, MWT, etc)

to be able to calculate the supportability

to be able to analyse what causes the length of the waiting times

Availability

to understand that this has to do with the time of the ready state for the equipment

to be able to define availability

to describe the connection and differences between dependability, availability, reliability, maintainability and supportability

to be able to calculate the availability with respect to down time, running time, operational cycles, production, calendar time, etc [GK]

to be able to analyse what causes low availability [GK]

to understand the influence of availability on the production [GK]

Improvements of the availability performance

to understand in which different ways it is possible to improve the availability

to understand in which different ways it is possible to improve the reliability (e.g. the choice of components, redundancies, design, preventive maintenance, better operational use, etc)

to understand in which different ways it is possible to improve the maintainability (e.g. design, documentation, maintenance equipment, education, etc)

to understand in which different ways it is possible to improve the supportability (e.g. assure faster access of personnel, documentation, spare parts, maintenance equipment, transports and assure faster administrative routines, etc)

Good Knowledge in:

The mathematical and statistical formulas to be used in the specifications and for verifications.

to be able to specify requirements regarding reliability performance (e.g. what is regarded as failures, active maintenance time, waiting time and how the availability is defined etc)

to describe the basic mathematical formulas within availability, reliability, maintainability and supportability

to be able to specify how the verification will be performed

to describe the different consequences if the verified results are different from the requirements [U]

Human reliability.

to describe the different types of human failures

to describe what causes human failures

to understand how human failures can be prevented and avoided

Production safety.

to describe the different types of incidents that the maintenance activities shall prevent (e.g. consequences on health, safety and environment)

to understand how to predict and prevent such consequences

to give examples of external parties interested in those preventions.

Risk analysis.

to be able to define risk

to describe the different steps in a general risk analysis to be able to calculate risks

to describe some different methods for risk analysis and when they can be used (e.g. FMEA and Fault-tree) [U]

to be able to judge on the quality of a performed risk analysis [U]

Understanding in:

Quality assurance

to define quality and quality assurance

to mention some standards and methods for quality assurance regarding maintenance

to describe how the maintenance activities will have an influence on the quality assurance

Laws and regulations (technical aspects).

to exemplify governmental organizations that are responsible for laws and regulations regarding maintenance

to exemplify organizations that are checking the application of these laws and regulations

to exemplify laws and regulations that have a direct influence on the maintenance activities

3.3 Maintenance Information Systems

Within this area it is essential to have knowledge about the different methods and systems that can be used in the decision making process, to be able to assure that the maintenance activities are cost effective and are supporting the company profit.

It is important to have good knowledge of how to specify the system requirements and how to develop and use the information systems for planning, control, feedback analysis and improvements. Therefore the following knowledge has to be obtained:

Very good knowledge in:

Maintenance Management Information Systems (key-figures, guidance tables and so on).

to describe different types of information systems and be able to combine these (e g the customer requirements on maintenance, the efficiency of the plant equipment and the machineries, the different contracts for the maintenance performance)

to be able to specify the requirements for an information system

Good knowledge in:

Maintenance Information Systems (for planning, work order, technical/economical analysis, and so on).

to describe different types of information for maintenance activities (e g work order, work control, planning, work preparation, spare parts, LCC/LCP, safety, risks, environment, production results, betterments, modifications, investments, etc)

to be able to specify the requirements for information systems that will handle the above

to describe the limits and the uncertainties that might exist in these systems

to be able to combine, prioritize and argue regarding the use of these systems

to be able to describe the different modules in a maintenance information system

Technical documentation/information systems

to be able to specify the requirements for a documentation system and give some examples of how the different documents shall look like (e g maintenance instructions, equipment lists, drawings, spare part lists, education/personnel information, handbooks, etc)

to describe how to organize the work to keep the systems updated

Technical process control systems

to be able to specify these systems

to describe the limits and the uncertainties that might exist in these systems

to be able to combine, prioritize and argue regarding the use of these systems

to describe the relationship between the process control system and the maintenance information system

Understanding in:

Expert systems

to define and describe the principle of an expert system, inclusive the different types of such systems

to describe the problems regarding the use of such systems

Basics concerning the computer support for the topics above.

to describe the basic ideas how to combine and prioritize the information systems mentioned above

to describe different ideas regarding the documentation system (e g paper - computerized, local - central, advantages - disadvantages, etc)

to be able to adapt the systems to the actual circumstances

to be able to indicate actual costs for these systems and the advantages to use them

to know the fundamental requirements regarding the security for information systems and the need of backup for computer systems

to describe how to use the results from these information systems

to describe the difficulties with these systems (e g collecting data, present data, etc)

to describe the principle concept how to handle a project regarding the implementation of a new system (e g the choice of system, preparation, installation, training, etc)

3.4 Maintenance Methods and Techniques

Within this area it is essential to have knowledge about the theories and methods that are used to optimize the mix between corrective maintenance, preventive maintenance (predetermined or condition based) and modifications.

It is important to have knowledge about how to choose the right methods for the best cost effective-ness.

Therefore the following knowledge has to be obtained:

Good Knowledge in:

The theory of the failure patterns.

to define a fault

to describe the different causes for a fault (e g specification, design, installation, operation, maintenance)

to understand the statistical distributions for failures to be able to choose the appropriate maintenance

method depending on the actual failure distribution (e g corrective, preventive, condition based, modification)

to be able to classify and take into account the different consequences of a fault

Types of wear and tear.

to describe the different causes of wear and tear

to describe the different possibilities to prevent that

Improvement techniques (aiming at reducing failure rates and down times).

to know and understand different methods of fault finding

to understand different methods of improvements due to maintenance requirements

to be able to specify, plan, control and follow up improvements

Preventive techniques.

to describe methods and techniques for predetermined and condition based maintenance

to understand and be able to decide about the intervals between preventive maintenance actions

to be able to choose a suitable preventive maintenance program (e.g. activities, intervals, etc)

Inspection techniques.

to describe methods and techniques for inspection (condition based maintenance)

to understand and be able to decide about the intervals between inspections

to be able to choose a suitable inspection system

Condition monitoring techniques.

(see "*Inspection techniques*" above)

Methods of life extensions.

to know different methods of life extensions, and how to execute them

to be able to describe in a visual way how different maintenance activities will have an influence on the life time of the production equipment

Measurement methods.

to understand the principles of measurement systems with indication and presentation for the purpose of maintenance

to describe typical methods to measure different technical conditions

Control systems.

to be able to describe different types of condition monitoring systems (e.g. continuous, by intervals, on request, centralized or decentralized)

Understanding in:

Performance improvement techniques.

to know and judge on the importance of different fault finding methods
to understand different methods of improvements due to maintenance requirements
to be able to specify, plan, execute and follow up performance improvements

Repair techniques.

to be able to plan, execute and follow up repair work
to be able to give examples of repair techniques

3.5 Maintenance terms in the English language

Within the language area it is essential to have good knowledge about the maintenance terms in the English language, in order to be able to handle international maintenance management matters within Europe. (This requirement only apply for those that like to have an EFNMS European Certificate, and does not apply for a National Certificate.)

Therefore the following knowledge has to be obtained:

Good knowledge in:

The understanding of maintenance terms in the English language

The rules to be able to achieve the EFNMS Certificate as a "European Expert in Maintenance Management"

1. General

An applicant has to fulfill the requirements regarding the theoretical knowledge and the practical experiences (as specified below) within one year to be able to get the EFNMS Certificate.

The date of the certification will be the date when the last of the requirements is fulfilled.

2. The requirements of theoretical knowledge

2.1. An examination

- 2.1.1. Each National Maintenance Society that is a member of the EFNMS will, on behalf of the EFNMS, arrange written examinations of the theoretical knowledge in each societies own language. (These examinations can be arranged at intervals that will suit each society.)
- 2.1.2. The examination has to be arranged according to national university standards.
- 2.1.3. The examination shall include:
 - [A] questions that cover the subjects in the detailed specification,
 - [B] one maintenance article in English, from which the students shall write an abstract in their own language.
- 2.1.4. The complete examination of [A] above shall last no more than 8 hours. The examination can be divided into two parts, with two different questionnaires. (e.g. one part with questions covering "Management and Organization" + "Maintenance Information Systems" and another part covering "Reliability Performance of Production Plants" + "Maintenance Methods and Techniques".)
- 2.1.5. The complete examination of [A] above shall give 100 points. To pass the examination a candidate has to achieve 70 points. If the examination is divided into two parts, as described in 1.1.4. above, the first part can give 55 points (to pass 40 points) and the second part 45 points (to pass 30 points.)
- 2.1.6. A separate examination of [B] above is allowed for 1 hour.
- 2.1.7. Regarding the examination of [B] above, a candidate shall prove a fully understanding of the maintenance terms in English to pass the test.
- 2.1.8. Present at the examination have to be the National Examiner (see 2.2.1. below), the EFNMS observer (see 2.4.2. below) and a member from the board of the National Maintenance Society.

2.2. A questionnaire preparation group for the examination

- 2.2.1. For the preparation of the questions in an actual examination, the National Maintenance Society has to select a group of professionals who are authorities within the area of maintenance management.

This group has to include as a minimum:

a professor and/or a teacher from a university

a maintenance manager from a medium or large company

a representative from the board of the National Maintenance Society

(In some cases the same person can cover more than one of the criteria above. However, the group shall not consist of less than three people and each of them has to fulfill at least one of the criteria above, and all the mentioned criteria have to be covered by the group.)

Among the above professionals a National Examiner shall be appointed.

2.2.2. The final proposal for the questionnaire has to be sent to an EFNMS observer (see 2.2.2. below) for approval. The approval has to be done by the signature of the observer on each sheet of the questionnaire. *A questionnaire that is not approved by the EFNMS observer is not valid for the purpose of the EFNMS certification.*

2.2.3. The questions for the written examinations have to be treated *confidential*. Nobody outside the preparation group and the EFNMS observers shall be able to know anything about the questions prior to the actual examination.

2.3. The questionnaire

2.3.1. The examination for [A] above shall include questions that cover the subjects in the detailed specification. *All subjects under the headings "Very good knowledge" have to be covered by the questions.*

The examination for [B] above can consist of an article in English, where the maintenance management aspects are covered. To pass the examination, a full understanding of the article and the right translation of the maintenance terms has to be proved.

2.3.2. The questionnaire has to be arranged according to national university standards.

2.4. The National Examiner and the EFNMS observer

2.4.1. The National Examiner will be selected among the members of the group of professionals (defined in 2.2.1. above) and will be in charge for running the examination according to 2.1. above

2.4.2. The selected EFNMS observer has to be a member of the EFNMS Certification Committee and belong to another National Society than the Society which conducts the examination.

The EFNMS observer shall understand the language in which the examination is done. His costs shall be paid by the Society which conducts the examination.

2.5. The evaluation of the examination

2.5.1. The evaluation of the examination has to be done by the National Examiner, a member from the board of the National Society and the EFNMS observer

2.5.2. The result has to be written down on each candidates answer form and signed by the National Examiner and the EFNMS observer (the EFNMS Examination Executor).

Unless both these signatures are present on the answer form, the examination result is not valid for the purpose of the EFNMS examination.

2.5.3. The result of the examination is final and can not be a subject of any appeal.

3. The requirements of practical experience

The applicant shall fulfill the following practical experiences:

At least 5 years experience in the field of maintenance, inclusive at least 2 years experience in a managing position in the field of maintenance. (At least one of these years should have occurred during the last 18 months.)

4. The EFNMS Certificate

The EFNMS will issue the Certificate (diploma), which will be signed by the EFNMS President, the National Society President and the EFNMS Examination Executor.

5. A register of Certified Experts in Maintenance Management

The EFNMS will make a register of all certified European Experts in Maintenance Managements that are certified according to these rules.

The names of the certified individuals may be published. (The names of those that not passed the test, shall not be published.)

6. The certification costs

For each issued certificate from the EFNMS, the National Society has to pay 50 ECU to the EFNMS.

This amount and a sum for the administration of the National Society has to be paid by the applicant (student). (The sum for the administration is to be decided by each National Society.)

7. Certificates from a National Maintenance Society

An individual who has fulfilled the requirement 2. [A] above will receive a national certificate from his (her) National Society that proves that he (she) has passed this examination.

Each national member society of the EFNMS has its right to issue a National Maintenance Society Certificate (diploma) as a "National Expert in Maintenance Management" for each national individual which has fulfilled the requirements 1., 2[A] and 3 above (The requirements regarding the English language and the EFNMS quality control are not included.)

The sum for administration to be paid by the applicant (student) is to be decided by each national society.