



STANDARDIZATION

EUROPEAN COMMITTEE FOR

*CEN/TC 319*

COMITÉ EUROPÉEN DE NORMALISATION

EUROPÄISCHES KOMITEE FÜR NORMUNG *Maintenance*

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**CEN/TC 319/WG 9 Qualification of Maintenance personnel**

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## 1. Introduction

There are over 20 Maintenance Societies in Europe, and each of them is active in education and training on a National level. In view of the ongoing developments in European integration, it is obvious that training and qualification of maintenance personnel should be done within a more structured framework of mutually accepted European guidelines.

## 2. Actual situation

About 15 years ago, an initiative was taken to develop European guidelines for qualifying Maintenance Personnel at a Management level. This project is still progressing with great success. One of the reasons for this success is that the qualification procedure has no link to any National school system hindering the initiative. In fact all individuals have a right to make an application to enter the examinations arranged by the National Member Societies.

At the beginning of the 1990s, the Societies decided uniformly to categorize the European maintenance personnel into three levels and to link these levels to National school systems.

The following three levels were described:

- . • The European Maintenance Technician
- . • The European Maintenance Supervisor
- . • The European Maintenance Manager

The European Maintenance Technician is a craft person with at least two years of practical experience in maintenance and sufficient theoretical knowledge to independently perform and coordinate maintenance activities (responsible for short term decisions and communication).

The European Maintenance Supervisor is a person with at least two years of practical experience in maintenance and sufficient theoretical knowledge to independently perform and coordinate maintenance projects (responsible for medium term decisions)

The European Maintenance Manager is a person with approved engineering background and sufficient theoretical knowledge to perform and co-ordinate maintenance.



### 3. The scope of this document is:

To define the competence levels for personnel operating in maintenance and the knowledge levels required to be addressed in order to carry out those competencies.

### 4. Three competence levels for qualification of Maintenance personnel

This document lists the knowledge requirements proposed for incorporation within maintenance training. There are proposed three levels of competence. The knowledge requirements are typically covered within the following education systems.

Title	European Maintenance Manager	European Maintenance Supervisor	European Maintenance Technician
Qualification document	Bachelor degree or Postgraduate diploma / Master degree	eg. National diploma	eg. National diploma
Education system / school	Technical university Private schools or courses	National school for improving theoretical knowledge	National school for improving theoretical knowledge
Starting conditions	Baccalaureate <b>or</b> Bachelor <b>or perhaps</b> European Maintenance Supervisor	Person with at least two years of practical experience in maintenance <b>or</b> European Maintenance Technician	Craft person with at least two years of practical experience in maintenance

Table 1: Example of the three levels for qualification of maintenance personnel

CEN propose that the three competence levels described are fully integrated in the lifelong learning programmes of the EU in accordance with the Bologna and Copenhagen declarations.

At the Maintenance Manager level, the education should be integrated into Bachelor or Master education syllabuses.



## 5. The three levels of required knowledge

The requirements have been set out under “General Competencies” and “Responsibilities and Competencies”; task related headings. These have sub-readings in each syllabus area with the level of required knowledge specified.

The three levels of required knowledge are:

- 1: Very good knowledge**, to be able to lead change and handle special tasks.
- 2: Good knowledge**, to be able to understand the implications of change and making the correct decisions.
- 3: Understanding**, to be able to participate in decision making within the team and carry out the tasks.

In each syllabus the overall approach is to ensure that maintenance tasks are:

- (a) carried out safely and in a safe manner,
- (b) carried out in a correct manner first time, and
- (c) carried out on time and cost effectively.

### 5.1 General Competences for the three levels

		<b>Maintenance Manager</b>	<b>Maintenance Supervisor</b>	<b>Maintenance Technician</b>
		<b>LEVEL OF REQUIRED KNOWLEDGE</b>	<b>LEVEL OF REQUIRED KNOWLEDGE</b>	<b>LEVEL OF REQUIRED KNOWLEDGE</b>
<b>1.0</b>	<b>Corporate/Company Environment</b>	<b>1</b>	<b>2</b>	
1.0.1	Corporate/company situation	<b>Has</b> knowledge to impact on social/economic impact of own organization / enterprise.	<b>Has</b> good knowledge of social/economic impact of own organization / enterprise.	
1.0.2	Corporate/company organization			
1.0.3	Departmental organization			
1.0.4	Costs			

<b>1.1</b>	<b>Work Planning</b>	<b>1</b>	<b>1</b>	<b>1</b>
1.1.1	Planning <ul style="list-style-type: none"> <li>- Maintenance request / Process sheet / Job ticket</li> <li>- Personnel planning</li> <li>- Equipment planning</li> <li>- Time sheet</li> </ul>	<b>Has</b> very good knowledge for organizing all maintenance activities, how to <b>choose</b> a suitable organization and <b>assure</b> the right competence within the organization.	<b>Does</b> preparation and reporting on team maintenance tasks and <b>is</b> supervising some team jobs. <b>Carries out</b> planning of shutdowns, and group planning coordination.	<b>Does</b> preparation and reporting on own maintenance tasks and on some team jobs. <b>Plans</b> own work and suppliers` / contractors` work.
1.1.2	Control and reporting			
<b>1.2</b>	<b>Team Working and Communications</b>	<b>1</b>	<b>1</b>	<b>1</b>
1.2.1	Authority and Responsibility	<b>Has</b> very good knowledge in project management.	<b>Has</b> ability to create and communicate procedures and systems. Reports orally and in writing within a team and to the management.	<b>Reports</b> orally and in writing within a team.
1.2.2	Basic Management Techniques <ul style="list-style-type: none"> <li>- Personnel Management</li> <li>- Reporting Techniques</li> <li>- Team organization techniques</li> </ul>	<b>Has</b> social capability to lead and communicate with people in and outside the team, such as in the production, with contractors, suppliers, etc. <b>Has</b> good knowledge about human reliability.	<b>Has</b> social capability to communicate with people in and outside the team, such as in the production, with contractors, suppliers, etc.	<b>Has</b> social capability to communicate with people in and outside the team, such as in the production, with contractors, suppliers, etc.
<b>1.3</b>	<b>English Language</b>	<b>1</b>	<b>2</b>	<b>3</b>
1.3.1	Technical English	<b>Has</b> good knowledge about the maintenance terms in the English language, in order to <b>be able</b> to handle international maintenance management matters within Europe.	<b>Is able</b> to understand instructions in technical English and to make a summary in the national language. <b>Is able</b> to conduct a conversation in English. <b>Is able</b> to write a case-study report in English.	<b>Is able</b> to understand instructions in technical English.

<b>1.4</b>	<b>Information Technology</b>	<b>1</b>	<b>2</b>	<b>2</b>
1.4.1	Basics of EDP related to maintenance management	<b>Knows</b> how to specify the requirements for an information system. <b>Has</b> good knowledge about the use of an information system.	<b>Uses</b> the information system for entering and collecting data. <b>Has</b> good knowledge to use the system interactively for tactical purposes.	<b>Uses</b> the information system for entering and collecting data. <b>Has</b> the basic knowledge to use the system interactively.
1.4.2	Processing / calculation techniques <ul style="list-style-type: none"> <li>- Data base handling</li> <li>- Computation of tables</li> </ul>			
1.4.3	The PC-Work station <ul style="list-style-type: none"> <li>- Organization of the PC-Work station</li> <li>- Use of networks</li> </ul>			
<b>1.5</b>	<b>Training and Instructions</b>	<b>1</b>	<b>1</b>	<b>2</b>
1.5.1	Basics of the Learning Process	<b>Has</b> very good knowledge for defining and implementing human resources development policy. <b>Has</b> very good knowledge needed for training and instructing. <b>Is</b> familiar with training facilities in and outside the organization.	<b>Has</b> very good knowledge needed for training and instructing team members. <b>Is</b> familiar with training facilities in and outside the organization.	<b>Has</b> the basic knowledge needed for training and instructing team members. <b>Is</b> familiar with training facilities in and outside the organization.
1.5.2	Basics of Training Strategies			
1.5.3	Basics of Planning a Lecture			
1.5.4	Training facilities			
<b>1.6</b>	<b>Quality Assurance (Systems)</b>	<b>1</b>	<b>1</b>	<b>2</b>
1.6.1	Scope and objectives of Quality Assurance <ul style="list-style-type: none"> <li>- QA Standards, Terminology</li> <li>- Elements of QA systems</li> </ul>	<b>Has</b> very good knowledge about the relationship between maintenance and quality assurance.	<b>Has</b> very good knowledge of the impact of maintenance on product quality. <b>Is able</b> to act as an active member of a quality team.	<b>Has</b> basic knowledge of the impact of maintenance on product quality. <b>Is able</b> to act as an active member of a quality team.
1.6.2	Basics of Quality Assurance			
1.6.3	QA techniques and procedures <ul style="list-style-type: none"> <li>- Concepts</li> <li>- Definitions</li> <li>- QA techniques and procedures</li> </ul>			
<b>1.7</b>	<b>Environment</b>	<b>1</b>	<b>1</b>	<b>1</b>
1.7.1	Scope and objectives of Environmental Management	<b>Has</b> very good knowledge and impacts on environmental issues. <b>Has</b> very good knowledge of the environmental consequences of carrying out and not carrying out maintenance.	<b>Has</b> very good knowledge of the impact of maintenance on environmental issues. <b>Is able</b> to act as an active member of an environmental team.	<b>Has</b> basic knowledge of the impact of maintenance on environmental issues. <b>Is able</b> to act as an active member of an environmental team.
1.7.2	Influence on environment			

<p><b>1.8</b></p> <p>1.8.1 1.8.2 1.8.3</p>	<p><b>Automation</b></p> <p>Basics of Process Control Basics of machine automation Common system design</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge of systems at present. <b>Understands</b> the principles of design of modern automation systems.</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge of systems at present.</p>	<p><b>2</b></p> <p><b>Has</b> general knowledge of systems.</p>
<p><b>1.9</b></p> <p>1.9.1 1.9.2</p>	<p><b>Occupational Health and Safety</b></p> <p>Scope and objectives of Health and Safety Management Influence on health and safety.</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge and impacts on health and safety issues. <b>Has</b> very good knowledge of the health and safety consequences of carrying out maintenance. <b>Has</b> knowledge of hazards, and protection and prevention techniques.</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge of the impact of maintenance on health and safety issues. <b>Is able</b> to act as an active member of a health and safety team.</p>	<p><b>1</b></p> <p><b>Has</b> knowledge of the consequences of maintenance on health and safety issues, and of protection devices and their use. <b>Has</b> good knowledge of procedures and working instructions, the requirements and the purpose. <b>Has</b> good knowledge of handling potentially hazardous materials. <b>Is able</b> to act as an active member of a health and safety team.</p>



## 5.2 Responsibilities and Competences for the three levels

		<b>Maintenance Manager</b>	<b>Maintenance Supervisor</b>	<b>Maintenance Technician</b>
		<b>LEVEL OF REQUIRED KNOWLEDGE</b>	<b>LEVEL OF REQUIRED KNOWLEDGE</b>	<b>LEVEL OF REQUIRED KNOWLEDGE</b>
<b>2.1</b>	<b>Maintenance Objectives, Policies and Strategies</b>	<b>1</b>	<b>2</b>	<b>3</b>
2.1.1	<p>Corporate Maintenance Engineering</p> <ul style="list-style-type: none"> <li>- Objectives, Tasks, Significance</li> <li>- Policies on maintenance</li> <li>- Investment considerations. LCC</li> <li>- KPI's and key targets</li> </ul>	<p><b>Knows</b> well the importance and consequences of maintenance objectives, policies and strategies.</p> <p><b>Knows</b> the economic impact of maintenance and the importance of operation and capital costs within the asset management framework.</p> <p><b>Has</b> an impact on design aspects from a maintenance point of view.</p> <p><b>Knows</b> different methods of life extensions.</p> <p><b>Knows</b> how to formulate the maintenance needs and goals.</p> <p><b>Knows</b> key-figures for maintenance control.</p>	<p><b>Knows</b> the importance of maintenance objectives and policies.</p> <p><b>Knows</b> the consequential impact of maintenance and the importance of operation and capital costs within the framework of asset management.</p>	<p><b>Understands</b> the importance of maintenance objectives and policies.</p> <p><b>Understands</b> the consequential impact of maintenance and the importance of operation and capital costs within the framework of asset management.</p>



<p><b>2.2</b></p> <p>2.2.1 2.2.2 2.2.3 2.2.4</p>	<p><b>Maintenance Concepts and Methodologies</b></p> <p>All maintenance procedures and systems Reliability and Maintainability principles Maintenance Asset Strategies (e.g. preventive, corrective, etc.) Condition Based Maintenance (see 2.7)</p>	<p><b>1</b></p> <p><b>Applies</b> the concepts and methods related to the collection and evaluation of information, the principles of maintenance asset strategy development, and its implementation and impact.</p>	<p><b>1</b></p> <p><b>Knows</b> and recommends the principles of the preventive, corrective and opportunity based maintenance, including condition monitoring.</p>	<p><b>1</b></p> <p><b>Carries</b> out the collection and assessment of data and information, and practices the concepts and methodologies developed.</p>
<p><b>2.3</b></p> <p>2.3.1 2.3.2</p>	<p><b>Restoration Techniques</b></p> <p>Basis of Technology  <ul style="list-style-type: none"> <li>- Mechanical Technology / mechanical equipment</li> <li>- Electrical Technology / electrical equipment</li> <li>- PLC's and PC's applications</li> <li>- Hydraulics and Pneumatics</li> <li>- Building</li> </ul> Repair techniques</p>	<p><b>1</b></p> <p><b>Knows</b> the different restoration techniques. Knows how to implement them.</p>	<p><b>1</b></p> <p><b>Knows</b> general restoration principles and is able to apply them in practice.</p>	<p><b>1</b></p> <p><b>Knows</b> specific restoration principles and is able to apply them in practice.</p>
<p><b>2.4</b></p> <p>2.4.1</p>	<p><b>Maintenance Terminology</b></p> <p>Terminology</p>	<p><b>1</b></p> <p><b>Knows and manages</b> the implementation of the correct general and specific maintenance terminologies, <b>understands</b> them and <b>is able</b> to use them effectively.</p>	<p><b>1</b></p> <p><b>Knows and understands</b> maintenance terminologies, understands them and <b>is able</b> to use them actively.</p>	<p><b>1</b></p> <p><b>Knows and understands</b> maintenance terminologies, <b>understands</b> them and <b>is able</b> to use them actively.</p>
<p><b>2.5</b></p> <p>2.5.1 2.5.2 2.5.3</p>	<p><b>Partnering and Contracting</b></p> <p>Basics of Contractual Law The CEN Maintenance Contract Guidelines  <ul style="list-style-type: none"> <li>- Practical applications</li> </ul> </p>	<p><b>1</b></p> <p><b>Knows</b> the principles of partnering and contracting. <b>Knows</b> well the laws, regulations, and procedures regarding human resources, liability, guarantee, environment, and energy, etc.</p>	<p><b>1</b></p> <p><b>Knows</b> the requirements and scope to which a contractor should comply. <b>Is able</b> to instruct and supervise contractors on maintenance jobs.</p>	<p><b>1</b></p> <p><b>Knows</b> the requirements and scope to which a contractor should comply. <b>Is able</b> to instruct and supervise contractors on maintenance jobs.</p>

<p><b>2.6</b></p> <p>2.6.1</p> <p>2.6.2</p> <p>2.6.3</p> <p>2.6.4</p> <p>2.6.5</p> <p>2.6.6</p>	<p><b>Laws and Regulations</b></p> <p>Basics of Human Resources</p> <p>Law and regulations on Health Care &amp; Safety</p> <p>Laws and regulations on environmental protection</p> <p>Safety practice</p> <ul style="list-style-type: none"> <li>- First aid training</li> <li>- Preventive health protection and safety measures</li> </ul> <p>Equipment Safety Systems</p> <p>All Laws and Regulations concerning the maintenance function</p>	<p><b>1</b></p> <p><b>Knows and can ensure</b> implementation of all functions, laws and regulations related to maintenance management.</p>	<p><b>2</b></p> <p><b>Knows</b> all relevant laws, regulations, and training procedures concerning job safety, fire protection and environment.</p>	<p><b>2</b></p> <p><b>Knows</b> all relevant laws and regulations concerning job safety, fire protection and environment.</p>
<p><b>2.7</b></p> <p>2.7.1</p> <p>2.7.2</p> <p>2.7.3</p>	<p><b>Condition Based Maintenance</b></p> <p>Significance of CBM in maintenance</p> <p>CBM procedures and techniques</p> <p>Measuring Techniques</p> <ul style="list-style-type: none"> <li>- Calibration of measuring tools and instruments</li> <li>- Disturbance, interference and noise</li> </ul>	<p><b>1</b></p> <p><b>Knows, and can apply</b> economically, different types of condition monitoring systems, measurement techniques and other suitable inspection systems. <b>Knows</b> how to implement them.</p>	<p><b>1</b></p> <p><b>Knows</b> the most common condition monitoring methods and devices and is familiar with their use in practice. <b>Can</b> project manage and assure the correct.</p>	<p><b>2</b></p> <p><b>Knows</b> the most common condition monitoring methods and devices and is familiar with their use in practice.</p>
<p><b>2.8</b></p> <p>2.8.1</p> <p>2.8.2</p>	<p><b>Fault Finding Techniques</b></p> <p>Root Cause Analysis</p> <ul style="list-style-type: none"> <li>- Analysis of functions</li> <li>- Analysis of design Fault</li> </ul> <p>Finding Techniques</p>	<p><b>1</b></p> <p><b>Knows</b> different fault finding methods (e.g. FMEA, Fault-tree). <b>Knows</b> when they can be applied, and how to use them. <b>Knows</b> how to manage the implications of different causes of a fault (e.g. specification, design, installation, operation, maintenance).</p>	<p><b>1</b></p> <p><b>Understands</b> different methods for systematic fault finding and is familiar with their use and practice. <b>Knows</b> how to describe the different causes for a fault (e.g. specification, design, installation, operation, maintenance).</p>	<p><b>1</b></p> <p><b>Understands</b> the appropriate methods for systematic fault finding and is familiar with their use and practice.</p>

<p><b>2.9</b></p> <p>2.9.1</p> <p>2.9.2</p>	<p><b>Improvement Concepts and Techniques</b></p> <p>Concept, definitions, scope</p> <ul style="list-style-type: none"> <li>- Small Scale Activities</li> <li>- Continuous improvement</li> </ul> <p>Workshop practice</p> <ul style="list-style-type: none"> <li>- Determination of weak points</li> <li>- Elimination of weak points</li> </ul>	<p><b>1</b></p> <p><b>Knows</b> the different improvement concepts (e.g. TPM, RCM, etc), and different improvement methods according to the maintenance requirements.</p> <p><b>Understands</b> and is able to discuss the financial aspects of asset life, and the associated development and procurement of new assets.</p>	<p><b>1</b></p> <p><b>Knows</b> improvement techniques and is familiar with their use and practice. <b>Knows</b> how to specify, plan, control and follow up improvements.</p>	<p><b>2</b></p> <p><b>Has</b> basic knowledge of improvement techniques and under direction is familiar with their use and practice. <b>Can</b> identify and report areas for improvement.</p>
<p><b>2.10</b></p> <p>2.10.1</p> <p>2.10.2</p>	<p><b>Documentation Management</b></p> <p>Basics of Engineering Drawings</p> <ul style="list-style-type: none"> <li>- Mechanical design</li> <li>- Wiring and piping diagrams</li> <li>- Electrical and electronic diagrams</li> </ul> <p>Organization and use</p> <ul style="list-style-type: none"> <li>- Filing</li> <li>- Retrieving</li> <li>- Marking up</li> </ul>	<p><b>1</b></p> <p><b>Has</b> very good knowledge for specifying the requirements for a documentation system (e.g maintenance instructions, equipment lists, drawings, spare part lists, education / personnel information, handbooks, etc) and document control procedures.</p>	<p><b>1</b></p> <p><b>Understands</b> all documentation (instructions, drawings, etc.) related to the maintenance job and <b>can</b>, if necessary, propose improvements and apply document control procedures.</p>	<p><b>2</b></p> <p><b>Understands</b> all documentation (instructions, drawings, etc.) related to the maintenance job and <b>can</b>, if necessary, propose improvements and handle non-conformance.</p>
<p><b>2.11</b></p> <p>2.11.1</p> <p>2.11.2</p>	<p><b>Spare Parts Management</b></p> <p>Administration of spare parts</p> <ul style="list-style-type: none"> <li>- Planning and organization of storing facilities</li> <li>- Cost accounting</li> </ul> <p>Documentation</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge of logistics support, material and store handling, methods for spare part management.</p>	<p><b>1</b></p> <p><b>Has</b> very good knowledge of the storing of spare parts. <b>Knows</b> the practical routine of storing and retrieval of spare parts.</p>	<p><b>1</b></p> <p><b>Has</b> basic knowledge of the storing of spare parts. <b>Knows</b> the practical routine of storing and retrieval of spare parts.</p>

<b>2.12</b>	<b>Materials Technology</b>	<b>1</b>	<b>1</b>	<b>2</b>
2.12.1	Materials Technology <ul style="list-style-type: none"> <li>- Metals</li> <li>- Synthetic materials</li> <li>- Ceramics</li> <li>- Glass</li> <li>- Building materials</li> <li>- Others</li> </ul>	<b>Has</b> very good knowledge of material technology and application, material deterioration and protective methods as well as Non destructive Testing methods.	<b>Has</b> basic knowledge of material technology and application, material deterioration and protective methods.	<b>Has</b> basic knowledge of material technology and application, material deterioration and protective methods.
2.12.2	Wear and Tear Mechanisms <ul style="list-style-type: none"> <li>- Corrosion</li> <li>- Fatigue</li> <li>- Stress</li> <li>- Friction</li> <li>- Others</li> </ul>			
2.12.3	Protective Methods <ul style="list-style-type: none"> <li>- Coating techniques</li> <li>- Tribology / lubrication</li> </ul>			
2.12.4	Non-destructive Testing methods			

## 6. What can be achieved through a structured qualification program?

- . • Consistency in the development of maintenance personnel on all three levels
- . • Structured European educational programs
- . • A common umbrella for competence in maintenance
- . • Focus on industrial requirements, including safety and environment
- . • Improved relationships between industry and training / educational.

## 7. References:

Regulations to achieve the EFNMS Certificate as a European Maintenance Specialist, EFNMS publication 20<sup>th</sup> of October 2001

Regulations to achieve the EFNMS Certificate as a European Maintenance Technician, EFNMS publication 1<sup>st</sup> of November 2003.