Text 1

https://mobility-work.com/blog/equipment-maintenance-vocabulary-search-clarity

Mobility Work

Vocabulary and technical terms of industrial maintenance

Technical content manager at Farinia Group, Ralitsa is interested in forging and casting techniques and the latest machinery and tools, and is curious about new manufacturing methods while respecting high-quality engineering.

Ralitsa Peycheva

CMMS

28 February 2017

The vocabulary used to qualify the interventions varies from one company to another and in big companies, even from one plant to another. Moreover, every experienced maintenance professional has an opinion regarding the meaning of terms and definitions. And although each country has a recognized standard organization, which has issued a dedicated maintenance vocabulary, the reality is that the maintenance world is very far from having a universal agreement concerning the meaning of basic maintenance terms and confusions of terms still occur.

Maintenance Terminology Can Cause a lot of Confusion

Many professionals believed that the adoption of CMMS a couple of years ago would motivate maintenance teams to establish clarity. But this didn’t happen! Two different plants would use the same CMMS, but two different vocabulary lists to designate the performed interventions. The same intervention would therefore be described differently from one site to another. And on the same site, two technicians would qualify/interpret the same intervention sometimes in different ways.

Use of a standard maintenance vocabulary is essential:

1. To express clear and precise ideas.
2. To initiate a constructive dialogue between the production and the teams of technicians in the company or group.

3. To compare different factories data within the same group.
4. To share analyzes, data and important files with other maintenance technicians working at other companies.
5. To obtain coherent KPIs approved and understood by all.

Forgotten definitions of basic equipment maintenance terms:

Maintenance: Maintenance is the set of actions performed to maintain or restore property in a specified state or to ensure a specified service. The maintenance department is in charge of these actions.

Equipment Availability: Availability means that the time available to a production team to operate a certain piece of equipment (machine's opening time) is devoted to the machine's main function: to produce.

For example, a packaging line with 100 hours per week available to the production team should, ideally, package products for 100 hours. Obviously, this is not realistic. A 100% availability of equipment is purely theoretical, but allows a good understanding of the concept.

A 95% availability means, from a maintenance point of view, that 5% of the time was consumed by maintenance, and 95% was devoted to production. The 5% correspond to the maintenance technician's interventions on the equipment: lubrication, control, repair of a belt, replacement of a detection cell, etc.

Measuring availability is therefore a good indicator of the performance of a maintenance department.

The measurement of equipment availability consists of:

1. The machine's opening time. For example: equipment that is scheduled from 5am on Monday morning to 5am on Sunday morning, including preparation and cleaning time, will thus have an opening time of 144 hours / week.
2. The time spent by the maintenance department on a piece of equipment which equals the total duration of the different interventions that affected the machine. In Mobility Work, this will be the total duration of the tasks associated with a piece of equipment.

We can then define the availability of piece equipment, normally expressed as a percentage.

Preventive Maintenance (PM) is planned maintenance, aiming at improving equipment life and avoiding unplanned maintenance interventions.

Total Productive Maintenance (TPM) encompasses proactive, preventive and autonomous maintenance actions. It is based on the 5 Japanese S: seiri – sort; seiton – set in order; seisso – shine; seiketsu – standardize; shitsuke – sustain and 8 supporting activities:

1. Autonomous maintenance
2. Planned maintenance

3. Quality integration
4. Focused improvement
5. Early equipment management
6. Training and education
7. Safety, health, environment
8. TPM in Administration

Corrective Maintenance is performed as fast as possible after a failure has occurred or has been identified to restore an asset to an operational condition respecting the scheduled times for in-service operations.

Asset maintenance management is a continuous improvement strategy for extending the lifecycle of assets (systems, facilities, equipment and processes) by ensuring their availability, safety and reliability. A solid asset maintenance management should decrease the frequency of breakdowns and minimize downtime.

Autonomous maintenance (level 1 maintenance) is a crucial component of TPM.**Autonomous maintenance** is carried out by the machine operators and not by dedicated maintenance technicians. Machine operators are expected to understand the functions and the components of the machines, detect any possible issues and perform corrective maintenance tasks.

Predictive maintenance: Compared to the time-based preventive maintenance, **predictive maintenance** analyzes the current condition of a piece of equipment and predicts a potential failure before it occurs. Thus, predictive maintenance enables maintenance technicians to foresee the exact moment of a breakdown and intervene only when necessary.

Spare parts management is the main component of an effective asset management program. **Spare parts management** ensures the proper planning and control of spare parts inventory in order to guarantee operational reliability and plant capacity. The right spare parts should be always available when needed and the right quantity of each spare part should be precisely defined in order to avoid excessive costs.

Ralitsa Peycheva

QUIZ

1-A task performed to identify, isolate, and rectify a fault so that the failed equipment, machine, or system can be restored to an operational condition within the tolerances or limits established for in-service operations.

What is it?

a. asset maintenance b. corrective maintenance c. predictive maintenance

2-Complete:

If you want to extend the life cycle of assets, you need to perform....

a. Asset maintenance management

b. Corrective Maintenance

c. Autonomous maintenance (level 1 maintenance)

3- Look for the **synonyms** for the following words. You have some extra words.

anticipate:

dependability:

allows:

extra:

Predictive maintenance: Compared to the time-based preventive maintenance, predictive maintenance analyzes the current condition of a piece of equipment and predicts a potential failure before it occurs. Thus, predictive maintenance enables maintenance technicians to foresee the exact moment of a breakdown and intervene only when necessary.

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foresee	asset	enables	piece	reliability	spare

Text 2

https://www.maintenanceandengineering.com/2020/04/16/bear-down-on-failure/

Bear down on failure

Note: bear down is a phrasal verb with different meanings

1. to press or weigh down

2. to approach in a determined or threatening manner/ to overcome

3. (of a vessel) to make an approach (to another vessel, obstacle, etc) from windward

4. (of a woman during childbirth) to exert a voluntary muscular pressure to assist delivery

Bear down on failure


Joshua Banks

April 16, 2020

Properly functioning bearings are vital for the efficient running of machinery. But without appropriate maintenance they can also be one of the main causes of equipment malfunction. Joshua Banks, bearing protection manager at AESSEAL, explains how an active approach to bearing care can improve reliability and avoid unnecessary costs.

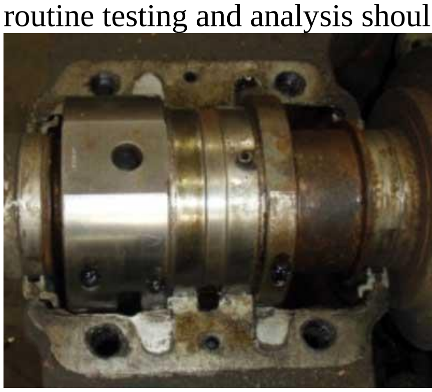
There are a number of reasons why bearings fail, but chief among them are particle contamination, inadequate lubrication and misalignment.

Collectively, these cause almost three-quarters of all bearing failures. But that could be reduced significantly, simply by making judicious decisions about the maintenance approaches and sealing solutions being employed.

Lubrication

Lubrication is often the poor relation in a condition-based maintenance programme. Even where routine lubrication is carried out, data may not be captured and guidelines fail to specify what, how and when it should be used.

Yet the condition of oil can tell you a lot about the condition of the equipment it is lubricating, so routine testing and analysis should be a fundamental part of any regular CBM programme.


Failure of this bearing was caused by water ingress.

Contamination

Contamination of the lubrication oil is the single most common cause of premature bearing failure and presents a serious impediment to achieving an L10 life cycle.

Research indicates that water contamination as low as 0.002% can reduce bearing life in some oils by as much as 48%. An oil-lubricated 45mm radial bearing running at constant load and speed under ultra-clean conditions (contamination factor $\eta_c = 1$) can complete 15,250 operating hours, whereas in contaminated conditions where $\eta_c = 0.02$, the bearing's operational life plummets to just 287 hours.

Contamination of the oil accounts for more than 20% of all bearing failures. If you can solve this issue, you will remove a major barrier to bearing reliability.

Misalignment

Machine components are typically coincident, parallel or perpendicular during operation. Any misalignment between the shafts of a driver and the equipment it is coupled to increases the stress on the shafts, leading to excessive wear and eventual breakdown. Bearing damage is a common by-product.

When the cost of repairing or replacing bearings and other components is added to that of lost production, the importance of accurate alignment becomes apparent.

Technology for reliability

Bearing failure is so common that some engineers simply factor downtime for repairs into the maintenance process.

However, contamination of the lubrication oil can be all but eliminated by replacing traditional lip seals with labyrinth-design bearing protector seals, which prevent the ingress of dust or moisture into the bearing chamber.

These highly durable seals can be retrofitted, require minimal maintenance and will protect a bearing throughout its natural lifespan of 12 years or more.

A pump fitted with a Machine Sentry sensor.

Cloud based CBM

Advanced cloud-based technology such as AVT Reliability's Machine Sentry has created an opportunity to introduce active, operator-driven CBM practices.

Safety and business-critical assets can be managed online, employing high-speed wireless connections to collect diverse data, including vibration and oil analysis, which can be consolidated on one platform from multiple locations, and securely accessed from anywhere via a standard web browser.

A key feature of the technology is its automated diagnostic assistant (ADA), which can predict stage 2, 3 and 4 bearing failure and detect a wide range of other common fault conditions.

The continuous availability of data provides a bedrock for a CBM plan. Lubrication can be effectively managed, failure detection becomes woven into the fabric of a maintenance programme, decision-making is better informed, and assets can be maintained to ensure optimum productivity.

This technology has become cheaper as its capabilities have become more sophisticated. It is scalable to any industrial plant and any maintenance team can use it, regardless of qualifications.

For every £1 spent on ADA technology, an estimated £5 is saved in time, expertise and hardware and software costs. Over a three-year period, uptime is increased by an estimated 33%. Parts are reduced by 23% and labour costs reduced by 16%, according to a 1997 benchmarking study.

These operational and financial benefits make a compelling case for considering investing in the solutions and technology to make bearing failures the exception rather than the norm.

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www.aesseal.co.uk | www.avtreliability.com

1-Is it true or false?

There are three reasons why bearings fail.

2- Is it true or false?

Contamination of the lubrication oil of the bearings rarely happens.

3- What is the meaning of **whereas** in the following sentence?

An oil-lubricated 45mm radial bearing running at constant load and speed under ultra-clean conditions (contamination factor $\eta_c = 1$) can complete 15,250 operating hours, **whereas** in contaminated conditions where $\eta_c = 0.02$, the bearing's operational life plummets to just 287 hours.

a. while b. as a result c. however

4- Look for the synonyms for the following words:

damage: failure: exact:

Machine components are typically coincident, parallel or perpendicular during operation. Any misalignment between the shafts of a driver and the equipment it is coupled to increases the stress on the shafts, leading to excessive wear and eventual breakdown. Bearing damage is a common by-product.

When the cost of repairing or replacing bearings and other components is added to that of lost production, the importance of accurate alignment becomes apparent.

5- What is the meaning of 'factor' in the following sentence?

Bearing failure is so common that some engineers simply factor downtime for repairs into the maintenance process.

a. to include as an essential element, esp. in forecasting or planning:

b. one of the things that influence whether an event happens or the way that it happens

an important/major/key factor.

c. a measurement that shows how strong or large something is

6-What is the meaning of the word 'key' in the following sentence?

A **key** feature of the technology is its automated diagnostic assistant (ADA), which can predict stage 2, 3 and 4 bearing failure and detect a wide range of other common fault conditions.

a. a small piece of metal used for opening or locking a door or a container, or for starting the engine of a vehicle

b. one of the parts that you press on a keyboard to make it produce letters, numbers etc

c. very important

7- The **acronym** for the following phrase is:

automated diagnostic assistant

8-What is the meaning of **bedrock** in the following sentence?

The continuous availability of data provides a **bedrock** for a CBM plan. Lubrication can be effectively managed, failure detection becomes woven into the fabric of a maintenance programme, decision-making is better informed, and assets can be maintained to ensure optimum productivity.

a. the ideas and principles on which a belief or system is based

b. the solid rock under the ground that supports the soil above it

9- Is it true or false?

Advanced cloud-based technology is still very expensive.

10-What do the highlighted words refer back to?

There are a number of reasons why bearings fail, but chief among **them** are particle contamination, inadequate lubrication and misalignment.

Properly functioning bearings are vital for the efficient running of machinery. But without appropriate maintenance **they** can also be one of the main causes of equipment malfunction. Joshua Banks, bearing protection manager at AESSEAL, explains how an active approach to bearing care can improve reliability and avoid unnecessary costs.

TEXT 3-

PREFACE _

1- **The following text is the preface of a book by B.S. Dhillon, published in 2002. Which do you think is the title of this book? Choose the best answer.**

Engineering maintenance is an important sector of the economy. Each year US industry spends well over $300 billion on plant maintenance and operation, and in 1997 the US Department of Defense's budget request alone included $79 billion for operation and maintenance. Furthermore, it is estimated that approximately 80% of the industry dollars is spent to correct chronic failures of machines, systems, and people. The elimination of many of these chronic failures through effective maintenance can reduce the cost between 40 and 60%. This century will usher in a broader need for equipment management—a cradle-to-grave strategy to preserve equipment functions, avoid the consequences of failure, and ensure the productive capacity of equipment. This cannot be achieved by simply following the traditional approach to maintenance effectively—human error in maintenance, quality and safety in maintenance, software maintenance, reliability-centered maintenance, maintenance costing, reliability, and maintainability also must be considered. Today, a large number of books are available on maintenance, but to the best of my knowledge, none covers all the areas listed above. Material on such topics is available either in technical articles or in specialized books, but not in a single volume. In order to perform the maintenance function effectively, knowledge of these topics is essential, but maintenance professionals find it difficult to obtain such information in a single maintenance text. The main objective of this book is to cover all the above and other related current topics in a single volume in addition to the traditional topics of engineering maintenance. The book focuses on the structure of concepts rather than the minute details. The sources of most of the material are given in references, which will be useful to readers who desire to delve deeper into specific areas.

Chapter 1 presents various introductory aspects concerning engineering maintenance including engineering objectives, engineering maintenance in the 21st century, and maintenance-related facts and figures. Chapter 2 reviews the basic probability theory and other pertinent mathematical topics that will help the reader understand subsequent chapters of the book. Chapter 3 discusses various aspects related to maintenance management and control, including department functions and organizations, elements of effective management, management control indices, and project control methods. Chapter 4 is devoted to preventive maintenance (PM) and covers topics such as preventive maintenance elements; steps for establishing a PM program; and PM measures, models, and advantages and disadvantages. Chapter 5 presents various aspects of corrective maintenance (CM) ranging from CM types and measures to CM mathematical models. Chapter 6 is devoted to the important subject of reliability centered maintenance (RCM) and covers topics such as RCM goals and principles, RCM process, RCM components, and RCM program effectiveness indicators. Inventory control in maintenance is presented in Chapter 7. This chapter covers topics such as inventory types and purposes, inventory control models, safety stock, and estimation of spare part quantity. Chapter 8 and 9 are devoted to human error in maintenance and quality and safety in maintenance, respectively. Some of the topics covered in Chapter 8 are facts and figures on human error in maintenance, maintenance error in system life cycle, guidelines for reducing human error, and techniques for predicting the occurrence of human error. Chapter 9 includes topics such as the need for quality maintenance processes, maintenance work quality, quality control charts for use in maintenance, post maintenance testing, safety and maintenance tasks, guidelines for equipment designers to improve safety in maintenance, and maintenance personnel safety. Chapter 10 presents various aspects concerning maintenance costing, including reasons for maintenance costing, factors influencing cost, labor and material cost estimation, cost estimation models, and cost data collection. Chapter 11 presents an important area of modern maintenance, i.e., software maintenance. Some of the topics relating to software maintenance are types of software maintenance, software maintenance problems, software maintenance tools and techniques, and software maintenance costing. Chapters 12 and 13 are devoted to two areas closely related to maintenance, i.e. reliability and maintainability. Chapter 12 covers reliability measures, reliability networks, and reliability analysis methods. Chapter 13 includes maintainability management in system life cycle, maintainability design characteristics, maintainability measures and functions, and common errors related to maintainability design.

This book will be useful to senior level undergraduate and graduate students in mechanical and industrial engineering; maintenance and operations, engineers; college and university level teachers; students and instructors of short courses in engineering maintenance; and equipment designers, managers, manufacturers, and users. The author is deeply indebted to many friends, colleagues, and students for their interest and encouragement throughout this project. I thank my children, Jasmine and Mark, for their patience and intermittent disturbances leading to desirable coffee and other breaks. And last, but not least, I thank my wife, Rosy, for typing various portions of this book, editorial input, proofreading, and tolerance.

a. Engineering maintenance: a modern approach

b. The cost of maintenance in the 21st century

c. The different chapters of the book

d. Traditional maintenance in engineering

2-What is this text about?

a. The different ways of reducing the cost of maintenance between 40 and 60%.

b. Effective maintenance in engineering.

c. The different chapters of a book on maintenance.

d. General information about the content of a book covering topics of engineering maintenance.

3- Who is the author of the book?

4- When was the book published?

5-Write the number of the chapter where you can find information about methods to analyse reliability.

6-Who does the author think should find this book useful?

a. Students, teachers and instructors in engineering maintenance, except the ones in colleges and universities.

b. A number of students and professional people related to different fields in mechanical and industrial engineering

c. Designers, manufactures and users, excluding students and university teachers.

d. Undergraduate and graduate students in mechanical and industrial engineering only.

7- TRUE OR FALSE?

Over twenty years ago, the Department of Defense of the USA was planning to spend more than seventy billion dollars for operation and maintenance.

8- TRUE OR FALSE?

The author thinks that, in general, all the material available on maintenance covers all the necessary areas.

9- TRUE OR FALSE?

You can read about human error in maintenance in Chapter 9 or the book.

10- TRUE OR FALSE?

Software maintenance is a modern aspect of maintenance.

11- Correct maintenance:

a. accounts for the 80% of the chronic failures in machinery

b. is an important measure to avoid excessive costs due to failures of machines and systems.

c. rarely reduces the cost of failures

d. costs between 40 and 60 % of the industry budget

12- The traditional approach to maintenance

a. is not enough for the current requirements in industry

b. is completely effective

c. includes human error, quality, safety and software maintenance.

d. is enough as it is mentioned in a large number of books on maintenance

13- Traditionally, maintenance professionals

a. must look for information on maintenance in a number of different sources

b. have been able to find all the information they need in only one book

c. are more interested in the structure of concepts than in the details

d. are difficult to find

14-Chapter 2

a. is a revision of the probability theory

b. comes before Chapter 1

c. is relevant to be able to understand other sections of this book

d. understand subsequent chapters of the book

15-In the following paragraph, what does the word "*this*" refer back to?:

This century will usher in a broader need for equipment management—a cradle-to-grave strategy to preserve equipment functions, avoid the consequences of failure, and ensure the productive capacity of equipment. ***This*** cannot be achieved by simply following the traditional approach to maintenance effectively—human error in maintenance, quality and safety in maintenance, software maintenance, reliability-centered maintenance, maintenance costing, reliability, and maintainability also must be considered.

a. the traditional approach to maintenance

b. preserve equipment functions, avoid the consequences of failure, and ensure the productive capacity of equipment

c. the productive capacity of equipment

16-In the following paragraph, what does the word "*none*" refer to?

Today, a large number of books are available on maintenance, but to the best of my knowledge, **none** covers all the areas listed above.

a. the author´s knowledge

b. available books

c. the current books on maintenance

17-In the following extract:

The book focuses on the structure of concepts rather than the minute details. The sources of most of the material are given in references, ***which*** will be useful to readers who desire to delve deeper into specific areas.

What does the word "***which***" refer back to?

a. sources of material

b. references

c. the structure of concepts

d. the minute details

18-In the spaces provided between brackets ( ), insert the synonym or definition given that corresponds to the word in **bold type**:

Chapter 1 presents various introductory aspects **concerning** (1) engineering maintenance including engineering objectives, engineering maintenance in the 21st century,and maintenance-related facts and **figures** (2). Chapter 2 reviews the basic probability theory and other **pertinent** (3)mathematical topics that will help the reader understand **subsequent** (4

)chapters of the book. Chapter 3 discusses various aspects related to maintenance management and control, including department functions and organizations, **elements** (5   )of effective management, management control indices, and project control methods. Chapter 4 is devoted to preventive maintenance (PM) and covers topics **such as** (6   )preventive maintenance elements; steps for establishing a PM program; and PM measures, models, and **advantages and disadvantages** (7   ). Chapter 5 presents various aspects of corrective maintenance (CM) ranging from CM types and measures to CM mathematical models. Chapter 6 is devoted to the important subject of reliability centered maintenance (RCM) and covers topics such as RCM goals and principles, RCM process, RCM components, and RCM program effectiveness indicators. Inventory control in maintenance is **presented** (8   ) in Chapter 7. This chapter covers topics such as inventory types and purposes, inventory control models, safety stock, and estimation of spare part quantity. Chapter 8 and 9 are devoted to human error in maintenance and quality and safety in maintenance, respectively. Some of the topics covered in Chapter 8 are facts and figures on human error in maintenance, maintenance error in system life cycle, **guidelines** (9   ) for reducing human error, and techniques for predicting the occurrence of human error. Chapter 9 includes topics such as the need for quality maintenance processes, maintenance work quality, quality control charts for use in maintenance, post maintenance testing, safety and maintenance tasks, guidelines for equipment designers to improve safety in maintenance, and maintenance personnel safety. Chapter 10 presents various aspects concerning maintenance costing, including reasons for maintenance costing, factors **influencing** (10   ) cost, labor and material cost estimation, cost estimation models, and cost data collection.

relating to	the following	affecting	relevant	aspects	like
instructions on how to do things		positive and negative aspects		introduced	
numbers					