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# ABBREVIATIONS

RAM expresses a combination of "Reliability" (R), Availability (A) and Maintainability (M)

LCC Life Cycle Costs

LRU Lowest Replaceable Unit

PM Preventive Maintenance

CM Corrective Maintenance

CHSM Chemical Substance or Mixture

MRT Mean Repair Time

MTBF Mean Time Between Failures

MDBF Mean Distance Between Failures

MTTF Mean Time To Failure

MDTF Mean Distance To Failure

# RELIABILITY

Reliability data are required for all purchased products. Reliability can be expressed as

* MTBF (h), ev. MDBF (km) for repairable products (product is used again after it has been repaired);
* MTTF (h), ev. MDTF (km) for non-repairable products (product cannot be repaired after a failure and it is disposed of);
* Failure rate  (h-1);
* other parameter, e.g. the number of failures for a certain period (FIT etc.), the number of operating cycles, etc.

In some cases, especially for more complex products, the supplier is requested to provide the customer the reliability analysis of the product, including data used for the analysis.

# DURABILITY

Value of durability is required for all purchased products.

It expressed as a "durability specified by the manufacturer", which expresses "the period during which the product is able to keep its technical parameters, without limitation perform its specified function, provided the proper use of the instructions for use and proper maintenance as prescribed in maintenance instructions”.

It is also expressed as "the length of the product life cycle" (LC) or "useful life."

# Maintainability

## Preventive maintenance

If the product requires preventive maintenance, the supplier is obliged to provide the Maintenance manual, in electronic form, containing as a minimum:

* recommended intervals for carrying out activities in preventive maintenance, expressed in time intervals, mileage, the number of operating cycles, etc.;
* procedures for maintenance activities, including procedures for parts replacement;
* list of parts of the product which have to be replaced within preventive maintenance, i.e. parts whose durability is shorter than the durability of the whole product;
* list and specification of special tools and fixtures or measurement devices necessary for maintenance;
* list of CHSM used in the product or necessary for maintenance (as defined in Maintenance manual);
* copies of Safety Data Sheets of CHSM according to Regulation (EC) No. 1907/2006 of the European Parliament and of the Council Concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

## Repairability and Corrective Maintenance

If the product is repairable after a failure, the supplier is obliged to specify whether the product is repairable on site (by the customer) or only by the manufacturer or by an authorized firm:

1. If the product can be repaired only by the manufacturer, the supplier is obliged to provide average cost of repair and the lead time of the repaired product;
2. If the product can be repaired by the customer, the supplier is obliged to provide the list of LRU (Catalogue of spare parts in electronic form) and other components or materials required for repair, including their prices, and maintenance instructions for corrective maintenance in electronic form, containing as a minimum:

* procedures for repair or replacement of LRU;
* estimation of a time necessary for the repair or replacement of defective part, expressed as "Mean Repair Time" MRT (h);
* specification of special tools and fixtures or measurement devices necessary for maintenance.

## Storability

The supplier is obliged to provide the specification of conditions for storage of supplied product if such conditions are specified by the manufacturer. In addition the supplier shall provide the time for which the product can be stored without degradation of its parameters.

These data can be stated in other documents, e.g. Operation or Maintenance manual.

# Life Cycle costs (lcc)

If the PM of the product is required and / or the product is repairable after the failure, the supplier is obliged to provide the information listed below for estimating the LCC of the product. Only the data of the costs related to maintenance (both PM and CM) are required, not complete LCC. Data shall be based on:

* length of the product Life Cycle (durability);
* results of reliability analysis of the product and its parts;
* results of maintainability analysis of the product.

The supplier shall provide following data for LCC estimation:

* time (in hours) and number of personnel necessary to perform the maintenance;
* supposed quantities of parts and other materials necessary to perform the maintenance;
* prices of all parts and other materials necessary to perform the maintenance.
* the cost of required testing after maintenance.

# Related documents

EN 50126-1:2017 Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part 1: Generic RAMS Process

# Annex

Questionnaire for suppliers: “Requirements for RAM / LCC of purchased products"





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