IEC 62550

Edition 1.0 2017-01

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Spare parts provisioning

Approvisionnement en pièces de rechange

IEC 62550:2017-01(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 03.120.01; 21.020

ISBN 978-2-8322-3834-9

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SPARE PARTS PROVISIONING

FOREWORD

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The text of this standard is based on the following documents:

FDIS	Report on voting
56/1711/FDIS	56/1719/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Spare parts provisioning is the process for planning necessary spare parts under consideration of a customer's needs and requirements.

Proper planning and control of spare parts is a critical component of effective supportability. If the right parts are not available when needed for routine maintenance or repairs, downtime is prolonged. If too many spare parts are available, the enterprise absorbs excessive costs and the overhead of carrying inventory.

Spare part planning and supply to achieve business objectives are based on four goals:

- the right spare part;
- in the right quantity;
- at the right time;
- at the right place.

Spare parts provisioning is a prerequisite for all types of maintenance tasks, such as replacements and repairs. Spare parts for corrective maintenance tasks should be supplied at random intervals for steady state availability. It may take three to four repairs before steady state availability is reached. In this period repairs may be clustered, and the need can vary significantly over time. For preventive and on-condition maintenance, fixed intervals or approximately fixed intervals for replacement items may occur. Coordination of demand for spare parts with supply of spare parts at the required time is an important factor. Unavailable materials are one of the most cited reasons for delays in the completion of maintenance tasks.

The availability of spare parts is one of the factors that impacts system downtime. Methodologies such as integrated logistic support (ILS) and its subsidiary logistic support analysis (LSA) provide necessary information for spare parts provisioning. This information includes system breakdown, maintenance concept, and supply concept. Spare part optimization will cover issues typically giving answers to questions such as:

- which spare parts should be stored within the maintenance organization or by a supplier?
- how many spare parts of each type should be stocked?

Spare part optimization is based on operations research methods and selected reliability methods and may be analytical or use Monte Carlo simulations. The optimization process aims at balancing the cost of holding spare parts against the probability and cost of spare part shortage.

Before spare parts can be ordered, procedures for procurement, administration and storage of required material should be specified. Additionally, a general supply concept should be compiled and specified.

Correct material supply procedures will guarantee that spare parts are ordered in time and delivered when requested. The procedures also include control of the repair of replacement parts as well as the monitoring of repair turn-around times. All organizations involved, from production to purchasing and storage, via maintenance, should have complete transparency about material availability and possible completion of the task. The planned material costs in the task should be compared with its consumption. These are then documented and form the basis of usage-controlled materials planning. With this process, inventory of spare parts can be optimized to meet availability requirements with minimum inventory levels.

This document is applicable to all industries where supportability has a major impact on the dependability of the item through its life cycle.

SPARE PARTS PROVISIONING

1 Scope

This document describes requirements for spare parts provisioning as a part of supportability activities that affect dependability performance so that continuity of operation of products, equipment and systems for their intended application can be sustained.

This document is intended for use by a wide range of suppliers, maintenance support organizations and users and can be applied to all items.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Some terms listed in IEC 60050-192 are also included here for the convenience of the reader.

3.1 Terms and definitions

3.1.1
consumables
any item which is expendable, may be regularly replaced and generally is not product specific

EXAMPLE Oil, grease, nuts, bolts and screws, gaskets, etc.

Note 1 to entry: Generally consumable items are relatively low cost.

3.1.2
corrective maintenance
maintenance carried out after fault detection to effect restoration

Note 1 to entry: Corrective maintenance of software invariably involves some modification.

[SOURCE: IEC 60050-192:2015, 192-06-06]

3.1.3
failure
<of an item> loss of ability to perform as required

Note 1 to entry: A failure of an item is an event that results in a fault state of that item: see fault [IEC 60050-192:2015, 192-04-01].

Note 2 to entry: Qualifiers, such as catastrophic, critical, major, minor, marginal and insignificant, may be used to categorize failures according to the severity of consequences, the choice and definitions of severity criteria depending upon the field of application.

Note 3 to entry: Qualifiers, such as misuse, mishandling and weakness, may be used to categorize failures according to the cause of failure.

[SOURCE: IEC 60050-192:2015, 192-03-01]

3.1.4
indenture level
level of sub-division within a system hierarchy

EXAMPLE System, subsystem, assembly, and component.

Note 1 to entry: From the maintenance perspective, the indenture level depends upon various factors, including the complexity of the item's construction, the accessibility of sub items, skill level of maintenance personnel, test equipment facilities, and safety considerations.

[SOURCE: IEC 60050-192:2015, 192-01-05]

3.1.5
integrated logistic support
ILS
<of an item> management process to determine and co-ordinate the provision of all materials and resources required to meet the needs for operation and maintenance

[SOURCE: IEC 60050-192:2015, 192-01-30]

3.1.6
item
subject being considered

Note 1 to entry: The item may be an individual part, component, device, functional unit, equipment, subsystem, or system.

Note 2 to entry: The item may consist of hardware, software, people or any combination thereof.

[SOURCE: IEC 60050-192:2015, 192-01-01, modified — omission of internal references and Notes 3, 4 and 5]

3.1.7
level of maintenance
maintenance level
set of maintenance actions to be carried out at a specified indenture level

[SOURCE: IEC 60050-192:2015, 192-06-04]

3.1.8
line replaceable item
LRI
replaceable hardware or software unit which can be replaced directly on the equipment by the user or by a maintenance support facility

Note 1 to entry: In some projects instead of LRI the term line replaceable unit (LRU) is applied.

3.1.9
maintenance
combination of all technical and management actions intended to retain an item in, or restore it to, a state in which it can perform as required

Note 1 to entry: Management is assumed to include supervision activities.

[SOURCE: IEC 60050-192:2015, 192-06-01]

3.1.10
maintenance policy
maintenance concept
definition of the maintenance objectives, line of maintenance, indenture levels, maintenance levels, maintenance support, and their interrelationships

Note 1 to entry: The maintenance policy provides the basis for maintenance planning, determining supportability requirements, and developing logistic support.

[SOURCE: IEC 60050-192:2015, 192-06-02]

3.1.11
line of maintenance
maintenance echelon
position in an organization where specified levels of maintenance are to be carried out

EXAMPLE 1st line – field; 2nd line – repair shop; and 3rd line – manufacturer's facility.

Note 1 to entry: The line of maintenance is characterized by the level of skill of the personnel, the facilities available, the location, etc.

[SOURCE: IEC 60050-192:2015, 192-06-03]

3.1.12
maintenance support
provision of resources to maintain an item

Note 1 to entry: Resources include human resources, support equipment, materials and spare parts, maintenance facilities, documentation and information, and maintenance information systems.

[SOURCE: IEC 60050-192:2015, 192-01-28]

3.1.13
maintenance action
maintenance task
sequence of elementary maintenance activities

EXAMPLE Fault localization, fault diagnosis, repair and function checkout.

[SOURCE: IEC 60050-192:2015, 192-06-11]

3.1.14
non-repairable item
item that cannot, under given conditions, after a failure, be returned to a state in which it can perform as required

Note 1 to entry: The “given conditions” may include technical, economic and other considerations.

Note 2 to entry: An item that is non-repairable under some conditions may be repairable under other conditions.

[SOURCE: IEC 60050-192:2015, 192-01-12]

3.1.15
obsolescence
transition from availability from the original manufacturer to unavailability or a permanent transition from operability to non-functionality due to external reasons

3.1.16
preventive maintenance
preventative maintenance
maintenance carried out to mitigate degradation and reduce the probability of failure

[SOURCE: IEC 60050-192:2015, 192-06-05, modified — deletion of Note1 to entry]

3.1.17
repairable item
item that can, under given conditions, after a failure, be returned to a state in which it can perform as required

Note 1 to entry: The “given conditions” may include technical, economic and other considerations.

Note 2 to entry: An item that is repairable under some conditions may be non-repairable under other conditions.

[SOURCE: IEC 60050-192:2015, 192-01-11]

3.1.18
spare part
component or part, either non-repairable or repairable, from the associated bill of material used to maintain or repair machinery or equipment

3.1.19
stock position
any location where a spare part is foreseen to be inventoried

Note 1 to entry: The terms stock and inventory are generally interchangeable.

3.1.20
supportability
<of an item> ability to be supported to sustain the required availability with a defined operational profile and given logistic and maintenance resources

Note 1 to entry: Supportability of an item results from the inherent maintainability, combined with factors external to the item that affect the relative ease of providing the required maintenance and logistic support.

[SOURCE: IEC 60050-192:2015, 192-01-31, modified — omission of internal reference]

3.1.21
system
<in dependability> set of interrelated items that collectively fulfil a requirement

Note 1 to entry: A system is considered to have a defined real or abstract boundary.

Note 2 to entry: External resources (from outside the system boundary) may be required for the system to operate.

Note 3 to entry: A system structure may be hierarchical, e.g. system, subsystem, component, etc.

Note 4 to entry: Conditions of use and maintenance should be expressed or implied within the requirement.

[SOURCE: IEC 60050-192:2015, 192-01-03]

3.2 Abbreviated terms

BOM	Bill of material
CS	Communication system
DCN	Data communication network
DTN	Data transport network
EBO	Expected backorders
FR	Fill rate
ILS	Integrated logistic support
IP	Initial provisioning

IPC	Illustrated parts catalogue
IPD	Initial provisioning data
LORA	Level of repair analysis
LRI/LRU	Line replaceable item/Line replaceable unit
MAD	Mean administrative delay
MoE	Measures of effectiveness
MDT	Mean down time
MLD	Mean logistic delay
MRT	Mean repair time
MTBF	Mean operating time between failures
MTBR	Mean time between replacements
MTD	Mean technical delay
MTTF	Mean time to failure
MTTR	Mean time to restoration
MWT	Mean waiting time
NFF	No fault found
NI	Not illustrated
NOR	Not operationally ready
OEM	Original equipment manufacturer
QPNHA	Quantity per next higher assembly
ROS	Risk of shortage
TAT	Turn-around time
TT	Transportation time

4 Overview

4.1 Participants and major steps in the spare parts provisioning process

Items, which are foreseen to be replaced during maintenance actions are defined as spare parts. The storage of spare parts is part of a comprehensive material provisioning process which ensures that the required spare parts for maintenance are provided in the necessary quantity, at the appropriate point in time and in the right place.

This document is applicable to items, which include all types of products, equipment and systems (hardware and associated software). Most of these require a certain level of maintenance to ensure that their required functionality, dependability, capability, and economic, safety and regulatory requirements are achieved.

The availability of a supported system is influenced by the overall effectiveness of maintenance. Thus, the availability of a system can be regarded as the general objective for spare parts provisioning. The potential impact of obsolescence should also be considered as an influencing factor (see IEC 62402).

The operator of an item has to offer a high level of service and performance. The maintenance organization is responsible for the effectiveness, elapsed time, and cost of the maintenance activities. An overview of specific responsibilities and targets as well as the major steps in the spare parts provisioning process are shown in Figure 1.

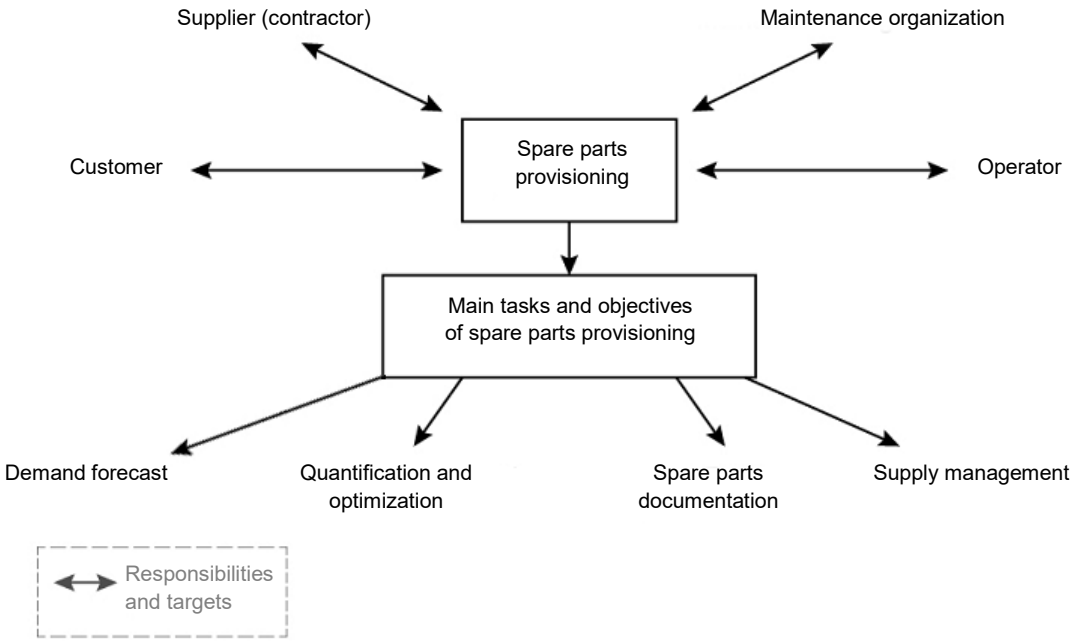

Figure 1 – Participants and major steps in the spare parts provisioning process

For satisfying the demand of spare parts, the following considerations have to be made:

- which spare parts are required;
- how many spare parts should be stocked;
- where should the spare parts be stored;
- when should the spare parts be ordered or reordered;
- what is the most economical solution for all participants.

In Table 1, responsibilities, targets and measurements for the different participants are shown as an example.

Table 1 – Responsibilities, targets, and measurements for suppliers, maintainers, operator and users

	Supplier of spare parts	Maintenance organization	Operator/user
Responsibility	appropriate spare parts availability quality of delivered items quality of supply service	high availability of maintained items high maintenance service	high operational availability
Target	profit with supply of spare parts certification of items (if required)	ensure that the system is successfully restored profit of the maintenance organization	operator: operational profit and availability user: high service performance
Measurements	service level lead time	system down times maintenance cost repair quality	system availability quality of service