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Varnost pakirnih naprav - 11. del: Ugotavljanje učinkovitosti in razpoložljivosti

Safety of packaging machines - Part 11: Determination of efficiency and availability

Sicherheit von Verpackungsmaschinen - Teil 11: Ermittlung von Effizienz und Verfügbarkeit

Sécurité des machines d'emballage - Partie 11 : Détermination de l'efficacité et de la disponibilité

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Safety of packaging machines - Part 11: Determination of efficiency and availability

Sécurité des machines d'emballage - Partie 11 : Détermination de l'efficacité et de la disponibilité

Sicherheit von Verpackungsmaschinen - Teil 11: Ermittlung von Effizienz und Verfügbarkeit

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 415-11:2021) has been prepared by Technical Committee CEN/TC 146 “Packaging machines - Safety”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2022, and conflicting national standards shall be withdrawn at the latest by April 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

EN 415, Safety of packaging machines consists of the following parts:

— *Part 1: Terminology and classification of packaging machines and associated equipment;*

— *Part 2: Pre-formed rigid container packaging machines;*

— *Part 3: Form, fill and seal machines;*

— *Part 4: Palletisers and depalletisers;*

— *Part 5: Wrapping machines;*

— *Part 6: Pallet wrapping machines;*

— *Part 7: Group and secondary packaging machines;*

— *Part 8: Strapping machines;*

— *Part 9: Noise measurement methods for packaging machines, packaging lines and auxiliary equipment, grade of accuracy 2 and 3;*

— *Part 10: General requirements.*

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

The operation of packaging machines and packaging lines is subject to numerous influences on the part of the machines and linking devices themselves, the upstream and downstream systems, the contents of the packaging, the packaging, the auxiliary packaging, the production organization, the service and maintenance personnel and the ambient conditions at the installation site. As a result, the packaging process is not disruption-free. During the operation of the packaging machine or packaging line, periods in which production takes place according to plan and to the required standard of quality stochastically interchange with periods in which disruptions lead to losses (e.g. due to scrap or production stoppages). This operating behaviour of a packaging machine or packaging line can be characterized by key figures, established from partial times on the basis of the structure of the machine working time and the output produced, or producible, during these periods.

This document defines a time model and an output model derived from this time model. These can be used to define general key figures and technical key figures for describing the operating behaviour of packaging machines and packaging lines. For this purpose, the technical key figures only take into consideration lost time and output losses that can be attributed to each packaging machine or packaging line examined.

Technical key figures are often based on agreed characteristics that are checked as part of an acceptance test. In practice, the system boundaries forming the basis of the acceptance test and that of the organizational and technical boundary conditions clearly influence the value determined for each key figure. This document specifies requirements for the proper performance of an acceptance test, the modalities of which should be agreed by the participating parties prior to the acceptance test being carried out.

The competence of the personnel responsible for the management of the packaging process plays an essential role.

Personnel (operators, maintenance people, quality staff) should be properly trained and be aware of the instruction provided by the manufacturer of the machine.

This document aims to promote mutual understanding between manufacturers and users of packaging machines and packaging lines with the respect to the use of terms and symbols (also referred as indicators) for the description of a packaging process.

The standard intends to enable the user of the standard to conduct a suitable test in which the operating conditions are correctly interpreted and attributed to shared causes.

For this reason, informative Annex D is offered which can be used with or without modifications in contractual specifications.

1 Scope

This document is applicable to packaging machines falling within the scope of EN 415-1, referred to in the following as “machine systems”. This document can also be applied by analogy to other related processing machines. This document specifies

— a time model,

— an output model derived from this time model,

— general key figures,

— technical key figures, and

— a methodology for system acceptance

for describing the operating behaviour of packaging machines and packaging lines.

This document does not contain safety requirements.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and symbols

3.1 Terms and definitions

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 https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
machine system
system
machines and lines with specified system boundaries regarding introduction of processing materials, operating materials, the release of output units, waste or scrap

3.1.2
processing material
referring to packaging machines: contents of the packaging, packaging, auxiliary packaging or package

3.1.3
output unit
processing material after passing through the machine system

Note 1 to entry: A packaging process consists of sub-processes in accordance with the basic tasks of packaging (i.e. forming, filling, sealing, wrapping) as well as the sub-tasks such as the cleaning of the packaging or labelling. In the context of this document, the packaging process comprises the respective machine system with the specified system boundaries. An output unit can be an intermediate product of the packaging process, a package or a loading unit.

3.1.4
acceptance
recognition of fulfilment of agreed characteristics of the machine system

3.1.5
acceptance test
test production to determine selected characteristics of the machine system

3.1.6
acceptance period
agreed duration of an acceptance test

3.1.7
disruption
unplanned event that compromises or interrupts the production of quality output units

3.1.7.1
system related disruption
disruption that can be attributed to the machine system considered

3.1.7.2
disruption not related to system
disruption that cannot be attributed to the machine system considered

3.1.8
start-up time
time period from the start of the loading of the first element in the machine system to the point in time when the first output unit leaves the final element of the machine system

3.1.9
emptying time
time period from the initiation of the production end of the machine system to the point in time when the last output unit leaves the final element of the machine system

3.1.10
time category
summary of time periods with the same specified use characteristics for the considered machine system

3.1.10.1
theoretically available time
t_T
theoretically available time

Note 1 to entry: 24 h for seven days of the week.

3.1.10.2
idle time
t_I
time period in which the machine system cannot be scheduled for production

3.1.10.3
machine working time
t_W
time period in which the machine system is scheduled for production

3.1.10.4
scheduled down time
t_D
scheduled time without the production of output units (e.g. for scheduled cleaning, maintenance, repair, equipping or adjustment of the machine system as well as product exchange)

Note 1 to entry: This is the difference between machine working time and operating time.

3.1.10.5
operating time
t_O
time period scheduled for the production of output units by the machine system

3.1.10.6
unplanned down time
t_F
unplanned time without the production of output units due to a disruption

Note 1 to entry: Unplanned down time can be determined automatically or manually.

3.1.10.6.1
system related unplanned down time
t_{FS}
sum of all system related unplanned down times

3.1.10.6.2
unplanned down time not related to system
t_{FE}
sum of all non-system related unplanned down times

3.1.10.7
running time
t_R
time period in which the machine system produces

Note 1 to entry: The machine system can produce scrap during running time.

3.1.10.8
scrap time
t_{LQ}
sum of the times in which the machine system does not produce in a manner conforming to the required standard of quality

Note 1 to entry: Mathematical variable.

3.1.10.9
performance loss time
t_{LP}
running time minus the sum of quality time and scrap time

Note 1 to entry: Mathematical variable.

Note 2 to entry: All loss times that cannot be attributed to the time categories t_{LQ} and t_F are attributed to t_{LP}.

Note 3 to entry: This time category includes calculated loss times due to a reduced working speed as compared with the set performance as well as scheduled and unscheduled times without performance that are not attributable to disruptions (e.g. due to start-up or emptying times or supply of processing materials (contents of packaging, packaging or auxiliary packaging)).

3.1.10.10
quality time
t_Q
time period in which the machine system produces in a manner conforming to the required standard of quality

Note 1 to entry: Mathematical variable.

3.1.10.11
loss time
t_L
sum of unplanned down time, scrap time and performance loss time

Note 1 to entry: Mathematical variable.

3.1.10.11.1
loss time caused by machine system
t_{LS}
sum of loss times that can be attributed to the machine system

3.1.10.11.2
loss time not caused by machine system
t_{LE}
sum of loss times that cannot be attributed to the machine system

Note 1 to entry: The reasons can be of a technical nature (e.g. effects of upstream or downstream systems, technical disruptions due to operating errors or packaging that does not comply with specifications) or of an organizational nature (internal or external organizational causes). Organizational causes include e.g. a shortage of product or packaging, unavailability of service or maintenance personnel, performance losses due to packaging or product qualities that do not comply with specifications, power failures, shortages of supply media.

3.1.11
output
sum of all output units in a specified time period

3.1.11.1
quality output
q_Q
output of output units conforming to quality produced in the operating time

Note 1 to entry: q_Q is referring to the output that can be produced in quality time.

3.1.11.2
scheduled output
q_O
scheduled quality output

Note 1 to entry: Planning variable.

Note 2 to entry: q_O is referring to the output that can be produced in operating time.

3.1.11.3
agreed output
q_{OA}
agreed output of output units conforming to quality in a specified time period

3.1.11.4
manufactured output
q_M
actual output of produced output units including scrap

3.1.11.5
output losses
q_L
difference between scheduled output and quality output

Note 1 to entry: Mathematical variable.

3.1.11.5.1
output losses caused by machine system
q_{LS}
output losses that can be attributed to the machine system

3.1.11.5.2
output losses not caused by machine system
q_{LE}
output losses that cannot be attributed to the machine system

3.1.11.5.3
scrap output
q_{LQ}
output of produced output units that do not comply with the specified quality requirements

Note 1 to entry: Product of good quality withdrawn for a quality check is not counted as scrap.

3.1.11.5.4
performance losses
q_{LP}
difference between scheduled output and manufactured output

3.1.12
performance
output units per time unit

3.1.12.1
nominal performance
p_n
performance for which the machine system has been calculated and designed for specified processing materials

Note 1 to entry: The nominal performance depends on the processing materials. Consequently, the machine system can exhibit different nominal performances.

3.1.12.2
set performance
p_s
theoretical performance achievable at a set working speed of the machine system

3.1.13
key figure
figure for the characterization of the use of a machine system

Note 1 to entry: Developed on the basis of use times, loss times and output losses that have been determined empirically or by simulation.

3.1.13.1
general key figure
key figure for the calculation of which all relevant loss times and output losses are taken into consideration

Note 1 to entry: No differentiation is made as to whether the determined loss times have been caused by the considered machine system itself or by factors external to the system.

3.1.13.1.1
quality performance
p_Q
quality output related to operating time

3.1.13.1.2
quality factor
Q
ratio of quality output to manufactured output

Note 1 to entry: The quality factor is determined based on output and can be converted to a time-based variable.

3.1.13.1.3
running time factor
R
ratio of running time to operating time

3.1.13.1.4
performance factor
P
ratio of manufactured output to scheduled output

Note 1 to entry: The performance factor is determined based on output and can be converted to a time-based variable.

3.1.13.1.5
availability
A
ratio of operating time to machine working time

Note 1 to entry: For technical availability see 3.1.13.2.2.

3.1.13.1.6
loading factor
L
ratio of machine working time to theoretically available time

Note 1 to entry: *L* not used in this document, but useful when the standard is used in link with OEE model.

3.1.13.1.7
overall equipment effectiveness
OEE
ratio of quality time to machine working time

Note 1 to entry: Scheduled down time is taken into consideration.

3.1.13.1.8
efficiency
E
ratio of quality output to scheduled output at a constant set performance at the level of the nominal performance of the considered machine system

Note 1 to entry: Scheduled down time is not taken into consideration.

Note 2 to entry: Unplanned down time and performance loss times are taken into consideration.

Note 3 to entry: $E \leq 1$.

3.1.13.1.9
mean time to repair
MTTR
mean duration of disruption-related down time of the machine system within the operating time

Note 1 to entry: Key figure for the evaluation of the system stability based on empirical data.

Note 2 to entry: Determination of a safe mean value for *MTTR* is not possible within an implementable acceptance period.