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Revision of R 87:

Quantity of product in prepackages

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This publication – reference OIML R 87, Edition xxxx (E) – was developed by Project Group 3 of Technical Committee TC 6 *Prepackaged products*. It was approved for final publication by the International Committee of Legal Metrology in xxxx and will be submitted to the International Conference on Legal Metrology in xxxx for formal sanction. It supersedes the previous edition of R 87 dated 2004.

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Quantity of product in prepackages

1 Scope

This Recommendation specifies

- legal metrology requirements for prepackaged products (also called prepackaged commodities or prepackaged goods) labeled in predetermined constant nominal quantities of mass, volume, linear measure, area, or count, and
- sampling plans and procedures for use by legal metrology officials in verifying the quantity of product in prepackages.

Note: The sampling plans are not recommended for use in the quantity control processes of the packer.

The following informative Annexes are also included:

- Annex A - an examination procedure outline where sampling is used;
- Annex B - procedures for determining average tare mass;
- Annex C - procedures for determining the drained quantity of products in liquid medium;
- Annex D - procedures for determining the actual quantity of frozen products;
- Annex E - requirements for prohibition of misleading prepackages;
- Annex F - basis for statistical sampling model used;
- Annex G - a schematic representation to explain the application of *T1* and *T2* errors;
- Annex H - an alternative sampling plan using a stepwise approach;
- Annex I - detailed sampling plans; and
- Annex J - references to documents mentioned.

2 Terminology

2.1 Definitions

2.1.1
actual quantity

amount of product that a prepackage contains as determined by measurement

Note: The actual quantity in a prepackage "i" is designated by the symbol Q_i or q_i.

2.1.2
error

2.1.2.1
average error

sum of individual prepackage errors considering their arithmetic signs divided by the number of prepackages in the inspection lot or sample

Note 1: The average error for all prepackages in a sample with sample size n is designated by the symbol e_{ave}.

Note 2: The average error for all prepackages in an inspection lot with N prepackages is designated by the symbol E_{ave}.

2.1.2.2
individual prepackage error

difference between the actual quantity of product in a prepackage and the nominal quantity of that prepackage

Note: The individual prepackage error for a prepackage "i" is designated by the symbol E_i or e_i and can be calculated by $E_i = Q_i - Q_{nom}$ or by $e_i = q_i - Q_{nom}$ where Q_{nom} is the nominal quantity.

2.1.2.3
***T1* error**

deficiency that is greater than the applicable tolerable deficiency (T) (see 2.1.~~15~~17) but not greater than twice the applicable tolerable deficiency ($2T$) for the given nominal quantity

$$T1 \text{ error: } (Q_{nom} - 2T) \leq Q_i < (Q_{nom} - T) \text{ where } Q_{nom} \text{ is the nominal quantity}$$

Note : See Annex G for an example of the application of errors.

2.1.2.4
***T2* error**

deficiency that is greater than twice the applicable tolerable deficiency ($2T$) for the given nominal quantity

$$T2 \text{ error: } Q_i < (Q_{nom} - 2T) \text{ where } Q_{nom} \text{ is the nominal quantity}$$

Note : See Annex G for an example of the application of errors.

2.1.3
inadequate prepackage

prepackage containing an actual quantity (see 2.1.1) that is less than the nominal quantity (see 2.1.7)

Note: An inadequate prepackage is sometimes also referred to as a non-conforming prepackage.

2.1.4
inspection lot

identified group of prepackages which will be inspected against the requirements of this Recommendation

Note 1: The symbol "*N*" is used to designate the lot size.

Note 2: Upper case letters are used as symbols related to the inspection lot in this Recommendation.

Note 3: An inspection lot is sometimes referred to as a batch.

2.1.5
medium

fluid that is put in the prepackage together with the product, either separated from, in or surrounding the product, and that is intended to be left over after use of the product, except for items naturally in the product

Note 1: For the purpose of this Recommendation a fluid includes either

a) a liquid, semi-liquid or frozen liquids, or
b) a gas or a mixture of gasses, whether under positive, negative or atmospheric pressure, or

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c) a combination of both a) and b).

Note 2: The term "use" includes consumption.

Note 3: A medium is sometimes also referred to as a "liquid packing medium".

Note 4: A medium can be separated from the product and other solid items that were put in the prepackage by measuring procedures in Annex C and Annex D.

Note 5: A medium also includes
a) the liquid mediums as specified in Clause 4.3.3 of the CODEX STAN 1-1985 "Labelling of prepackaged foods" which covers foods on which the drained mass must be marked[1], and
b) the ice-glaze as specified in CODEX standards on ice-glazed foods.

2.1.6
misleading prepackage

prepackage that is made, formed, presented, marked or filled in any way that may mislead a consumer about the quantity of contents that it contains

2.1.7
nominal quantity

quantity of product in a prepackage declared on the label

Note 1: The symbol "Q_{nom}" is used to designate the nominal quantity.

Note 2: In some national legislation the nominal quantity of the product is referred to as "net quantity", "net contents", "net mass" or "net volume".

Note 3: The nominal quantity should be declared in accordance with OIML R 79 [1].

2.1.8
packing material

everything of the prepackage that is intended to be left over after use of the product, except for items naturally in the product

Note 1: The term "use" includes consumption.

Note 2: Packing material is generally used to contain, protect, handle (e.g. lollipop stick), deliver, preserve (e.g. ice or glazing), transport, inform about and serve as an aid (e.g. food serving tray) while using the product it contains.

Note 3: Packing material also includes the container, ice (not naturally in the product e.g. glazing), solid items that were put in the prepackage together with the product such as wrappers, lollipop sticks, wax around cheese, and a medium that was put in the prepackage together with the product and that is intended to be left over after use of the product.

Note 4: Packing material is sometimes referred to as individual package, tare, packaging, or packaging material.

[1] CODEX STAN 1-1985 Clause 4.3.3: "In addition to the declaration of net contents, a food packed in a liquid medium shall carry a declaration in the metric system of the drained weight of the food. For the purposes of this requirement, liquid medium means water, aqueous solutions of sugar and salt, fruit and vegetable juices in canned fruits and vegetables only, or vinegar, either singly or in combination."

2.1.9
prepackage

single item for presentation as such to a consumer, consisting of a product and its packing material, made up before being offered for sale and in which the quantity of the product has a predetermined value, whether the packing material encloses the product completely or only partially, but in any case in such a way that the actual quantity of product cannot be altered without the packing material either being opened or undergoing a perceptible modification

Note 1: For the purpose of this Recommendation "prepackage" includes those prepackages marked with a constant nominal quantity and thus excludes those prepackages marked with random nominal quantities. The term "predetermined value" refers to the value determined prior to the prepackage being offered for sale.

Note 2: The actual quantity of some products may change after packing due to desiccation or chemical reactions.

2.1.10
prepackage marked with constant nominal quantity

prepackage on which the same nominal quantity is declared

2.1.11
prepackage marked with random nominal quantities

prepackage individually measured and marked with its actual quantity at the time of packing

2.1.~~10~~12
product

all of the prepackage that is not packing material

Note 1: Product includes liquids or gasses that were put in the prepackage together with the product and that are not intended to be left over after use of the product (e.g. air in chocolate mousse).

Note 2: Product includes liquids or gasses that were not put in the prepackage with the product and that are intended to be left over after use of the product (e.g. liquid in mozzarella cheese, air in hair gel).

Note 3: Product includes liquids or gasses that were not put in the prepackage with the product and that are not intended to be left over after use of the product (e.g. curdling of yoghurt or honey).

2.1.~~11~~13
random sampling

sampling procedure where prepackages to be included in a sample are chosen randomly from the inspection lot (i.e. each prepackage in the inspection lot has an equal probability of being selected to be included in the sample)

Note: This is also referred to as "sampling without replacement".

2.1.~~12~~14
sample

set of prepackages taken at random from an inspection lot to be inspected to determine conformance with specified criteria for purposes of making decisions concerning acceptance or rejection of the entire inspection lot

Note: Lower case letters are used as symbols related to the sample in this Recommendation.

2.1.~~13~~15
sample correction factor (*SCF*)

The factor calculated using

a) the Student's t inverse cumulative distribution function ($t_{p,\,n-1}$) with p as the probability equivalent to 0.005 and (n–1) as the degrees of freedom, and
b) a finite population correction factor (N–n)/(N–1) with n as the sample size and N as the inspection lot size

$$SCF = \frac{-t_{0.005,\,n-1}}{\sqrt{\frac{n(N-1)}{(N-n)}}}$$

Note 1: *SCF* always has a positive sign because $t_{p,\,n-1}$ has a negative sign for $p = 0.005$.

Note 2: See Annex F, F.3 for the statistical background to *SCF*.

2.1.~~14~~16
sample size

number of prepackages taken from an inspection lot and included in a sample

Note: The symbol "*n*" is used to designate the sample size.

2.1.~~15~~17
tolerable deficiency

permitted deficiency in the quantity of product in a prepackage

Note 1: The symbol *"T"* is used to designate tolerable deficiency.

Note 2: Tolerable deficiency is sometimes referred to as the tolerable negative error, limits of error or tolerances.

Note 3: By convention *T* is a positive number but, in use it represents a negative value of quantity, or negative error.

2.2 Acronyms and symbols

~~*AC* Acceptable number of prepackages with *T1* errors contained in a sample applied in a sampling inspection.~~

AGM	Actual Gross Mass which is equivalent to the actual mass of the prepackage (Annex A).
ATM	Average Tare Mass which is equivalent to the actual mass of the packing material (Annex A).
C	Arbitrary constant (Annex F).
CGM	Calculated Gross Mass (Annex A).
d_i	Difference between the individual prepackage error and the average error ($d_i = e_i - e_{ave}$ in Annex A).
E_{ave} and e_{ave}	Average of errors for all prepackages in an inspection lot and in a sample,

	respectively ($E_{ave} = Q_{ave} - Q_{nom}$ and $e_{ave} = q_{ave} - Q_{nom}$).
E_i and e_i	Error of quantity of product in an individual prepackage in an inspection lot and in a sample, respectively ($E_i = Q_i - Q_{nom}$ and $e_i = q_i - Q_{nom}$).
H_{T1} and H_{T2}	Proportion of prepackages with *T1* and *T2* errors, respectively, in the inspection lot (Annex H). $H_{Ti} = N_{Ti} / N$ (where i = 1 or 2).
h_{T1} and h_{T2}	Proportion of prepackages with *T1* and *T2* errors, respectively, in a sample (Annex H).
k_1	Arbitrary constant which means the maximum number of *T1* error packages that is listed in Column ~~4~~ 3 of Table 2 (Annex F).
M, M_{e1} and M_{e2}	Masses of drained product, clean sieve and sieve plus product after draining, respectively (Annex C).
M_w	Mass (in g) of a weight with a density of 8.0 g/mL (Annex A).
N	Lot size which is equivalent to the total number of prepackages contained in an inspection lot.
n	Sample size which is equivalent to the total number of prepackages in a sample.
N_{T1} and N_{T2}	Number of prepackages with *T1* and *T2* errors, respectively, in the inspection lot (Annex H/ F).
n_{T1} and n_{T2}	Number of prepackages with *T1* and *T2* errors, respectively, in the sample (Annex H/F).
NormsDist (Z)	Normal Cumulative Distribution Function in Excel which gives a probability (P) for a Z value. The standard deviation and the average of the distribution are assumed to be 1 and 0, respectively. Typical values given by this function are; NormsDist ($-\infty$) = 0, NormsDist (0) = 0.5 and NormsDist ($+\infty$) = 1.
NormsInv (P)	Inverse Normal Cumulative Distribution Function in Excel which gives a Z value for a probability (P).
$P(x)$	Probability function in which a criterion x is satisfied (Annex F).
P_{ac}	Probability for accepting an inspection lot (Annex H).
Q_{ave}	Mean value of actual quantities (Q_i) in all prepackages in an inspection lot.
q_{ave}	Mean value of actual quantities (q_i) in all prepackages in a sample.
Q_i and q_i	Actual quantity in an individual prepackage in an inspection lot and in a sample, respectively.
Q_{nom}	Nominal quantity declared on the label of a prepackage.
Round (x)	Normal rounding method, where a real value (x) larger than or equal to [J−0.5] and less than [J+0.5] is rounded to an integer J. When this function is used in Microsoft Excel, a parameter of zero should be added as 'Round (x, 0)'.
s	Sample standard deviation for actual quantities (Q_i) in all (or a group) of prepackages contained in a sample.
SCF	Sample Correction Factor defined in 2.1.~~13~~ 15 which is always a positive value.
T	Tolerable deficiency defined by Table 1 in 3.4.
$t_{p,f}$	Student's t inverse cumulative distribution function with two parameters of

probability (p) and number of freedom (f).

Z Standard normal random variable or z-score which is used to calculate the probability of a score occurring within a normal distribution and facilitates the comparisons of scores from different normal distributions [z-score = (x – mean)/standard deviation)] (Annex F).

μ Population mean value of an inspection lot (Annex F).

σ Population standard deviation for actual quantities (Q_i) in all prepackages contained in an inspection lot.

ρ Density of product (Annex A).

3 Metrological requirements for prepackages

3.1 General

Prepackages shall meet the requirements in 3.2 and 3.3 at any level of distribution including at the point-of-pack, import, distribution and wholesale transactions, and sale (e.g. where a prepackage is offered or exposed for sale).

3.2 Average requirement

The average actual quantity of product in prepackages shall be at least equal to the nominal quantity.

Note: 4.2 and 4.3 give criteria to be met if the average actual quantity of product in prepackages in an inspection lot is estimated by sampling.

3.3 Individual prepackage requirements

3.3.1 The actual quantity of product in a prepackage shall accurately reflect the nominal quantity but tolerable deficiencies (T) shall be allowed (see 3.4 and Table 1).

3.3.2 A homogenous group of prepackages shall contain no more than 2.5 % of packages having *T1* errors.

Note: 4.2 and 4.3 give criteria to be met if this requirement is evaluated by sampling prepackages from an inspection lot.

3.3.3 No prepackage shall have a $T2$ error.

3.4. Tolerable deficiencies

For all prepackages, the tolerable deficiencies (T) are specified in Table 1.

Note: 3.3 gives requirements for the application of tolerable deficiencies to individual prepackages in the sample.

Table 1 - Tolerable deficiencies in actual content for prepackages

Nominal quantity of product (Q_{nom}) in g or mL	**Tolerable deficiency *(T)*** [a]	
	Percent of Q_{nom}	**g or mL**
0 to 50	9	-
50 to 100	-	4.5
100 to 200	4.5	-
200 to 300	-	9
300 to 500	3	-
500 to 1 000	-	15
1 000 to 10 000	1.5	-
10 000 to 15 000	-	150
Above 15 000	1	-

[a] *T* values are to be rounded up to the next 0.1 of a g or mL for Q_{nom} less than or equal to 1 000 g or 1 000 mL and to the next whole g or mL for Q_{nom} higher than 1 000 g or 1 000 mL.

Nominal quantity of product (Q_{nom}) in length	**Percent of Q_{nom}**
$Q_{nom} \leq 5$ m	No tolerable deficiency allowed
$Q_{nom} > 5$ m	2

Nominal quantity of product (Q_{nom}) in area	**Percent of Q_{nom}**
All Q_{nom}	3

Nominal quantity of product (Q_{nom}) in count	**Percent of Q_{nom}**
$Q_{nom} \leq 50$ items	No tolerable deficiency allowed
$Q_{nom} > 50$ items	1 [b]

[b] Calculate the value of *T* by multiplying the nominal quantity by 1 % and rounding the result up to next whole number. The value may be larger than 1 % due to the rounding but this is accepted because the products are whole items and cannot be divided.

4 Reference test for metrological requirements

4.1 General inspection requirements

4.1.1 Legal metrology officials shall conduct tests to determine whether prepackages comply with the requirements of this Recommendation. The tests may be performed by sampling prepackages at any level of distribution including at the point-of-pack, import, distribution and wholesale transactions, and sale.

Note: Practical timing and place of metrological control may be chosen by the national responsible body.

4.1.2 An inspection lot taken from the production line shall consist of all prepackages not rejected by a checking system. Care shall be taken to prevent other than normal operating adjustments or other corrective actions in the production and prepackage filling process. Sample prepackages must be collected after the point of final checking by the packer.

4.1.3 The expanded uncertainties (at the k=2 level of confidence) associated with measuring instruments and test methods used for determining quantities shall not exceed 0.2 T. Examples of the source of uncertainty include the maximum permissible error and repeatability in weighing and measuring instruments, variations in packing material and fluctuations in density determinations caused by the differing amounts of solids in the liquid or temperature changes.

4.1.4 An inspection shall consist of checking the following three values irrespective of whether or not a sample is used to inspect compliance of the inspection lot:

a) the average error of the lot (see 3.2).
b) the number of inadequate prepackages in the inspection lot that have a *T1* error (see 3.3.2).
c) the number of inadequate prepackages in the inspection lot that have a *T2* error (see 3.3.3).

Note: National legislation may permit allowances in addition to tolerable deficiencies for the loss of quantity of product after packaging caused by ordinary and customary exposure to environmental conditions that occur in storage and distribution in the evaluation of both the average and individual prepackage requirements. These additional allowances would typically not apply to products packed in hermetically sealed (airtight) packing material.

4.1.5 An inspection lot is

a) accepted if it satisfies the requirements fixed for the three parameters above, or
b) rejected if it does not satisfy one or more of the requirements.

4.2 Control by sampling of inspection lots

~~**Control by sampling of inspection lots**~~

4.2.1 Metrological requirements when an inspection lot is sampled.

~~Metrological requirements when an inspection lot is sampled.~~

The tests for acceptance or rejection of inspection lots shall be conducted on the basis of random sampling (see 2.1.~~11~~ 13 and 4.3). Inspection lots shall consist of prepackages that have been produced under conditions that are presumed to have been uniform (homogeneous). A random sample of sample size n shall be selected from the inspection lot. The parameters in 3.2 and 3.3 shall be applied to the sample as follows:

a) Average requirement - The average of the actual quantities of product in the

prepackages of an inspection lot shall be at least equal to the nominal quantity. The probability of incorrectly rejecting an inspection lot which satisfies this requirement shall be no more than 0.5 %. The probability of correctly rejecting an inspection lot with an average actual quantity less than $Q_{nom} - 0.74\sigma$ shall be at least 90 %.

Note: σ is the standard deviation of the full population of the inspection lot (see Annex F) whereas s is the standard deviation of the sample of sample size n.

b) Individual prepackage requirement - The actual quantity of product in a prepackage shall accurately reflect the nominal quantity, however, deviations shall be allowed (see 3.3). In the case that an inspection lot contains 2.5 % of prepackages with *T1* errors the probability of acceptance through sample testing shall be at least 95 %. In the case that an inspection lot contains 9 % of prepackages with *T1* and *T2* errors the probability of correctly rejecting through sample testing be at least 90 %.

Note: The numerical criteria (2.5 % and 9 %) may not be strictly applied when a number of inadequate prepackages is rounded (see 4.5 Notes).

4.3 Statistical principles of control by sampling

4.3.1 Test of average requirement

Reject the lot if $\frac{e_{ave}}{s} + SCF < 0$

where s is the sample standard deviation of the individual errors, and *SCF* is found in column 4 of Table 2 or calculated using the formula in 2.1.13.

a) This test guarantees that the probability of incorrectly rejecting an inspection lot which satisfies the requirement set out in 4.2.1 a) is no more than 0.5 %.

b) This test also guarantees that lots with average actual quantity less than $Q_{nom} - 0.74\sigma$ will be correctly rejected with probability of at least 90 %.

Note 1: An alternative formula would be $q_{ave} < Q_{nom} - SCF \times s$

Note 2: See A.2.8 and F.3 for the statistical background to this average requirement.

4.3.2 Test of individual prepackage requirement for *T1* errors

Reject the lot if the number of prepackages having a *T1* error is larger than the number in column 3 of Table 2.

a) This test guarantees the probability of incorrectly rejecting an inspection lot that satisfies the criteria set out in 4.2.1 b) is no more than 5 %.

b) This test also guarantees that a lot which has 9 % of the packages having *T1* and *T2* errors will be correctly rejected with a probability of at least 90 %.

4.3.3 Test of individual prepackage requirement for *T2* errors

Reject the lot if the number of prepackages having a *T2* error is larger than zero.

There shall be no inadequate prepackages in the sample that have a *T2* error.

4.4 Lot size for inspection purposes

4.4.1 When sample prepackages are collected from the production line, the size of the inspection lot shall be equal to the maximum hourly output of the production line without any restriction as to the inspection lot size.

4.4.2 When sample prepackages are collected at the premises of the packer but not from the production line (where the hourly production is known), the size of the inspection lot shall be equal to the maximum hourly output of the production or 100 000 whichever is the lesser.

4.4.3 When the sample prepackages are not collected at the premises of the packer (where the hourly production or original lot size is not known) then the inspection lot size shall be defined by the legal metrology official but shall not exceed 100 000. The inspection lot shall be regarded as being homogeneous.

Note: Generally the legal metrology official should take the number of prepackages available as the inspection lot size.

4.5 Sampling characteristics

For a given inspection lot size (N), Table 2 specifies the minimum sample size (n), the acceptable number of prepackages with *T1* errors and the sample correction factor (*SCF*).

Detailed sampling plans are given in Annex I.

Table 2 – Sampling plan for discreet numbers of inspection lot sizes *N*

Inspection lot size, N	Sample size, n	Number of prepackages allowed with *T1* error	*SCF*	
20 or less	Total inspection	0	NA	
40	32	1	0.22	
60	35	1	0.30	
80	47	2	0.25	
100	49	2	0.28	
200	64	3	0.27	
300	67	3	0.29	
400	81	4	0.26	
500	81	4	0.27	
600 to 100 000	98	5	600 to 656	0.24
			657 to 1 261	0.25
			1 262 to 31 094	0.26
			31 095 to 100 000	0.27

Note 1: The above table uses the normal ~~a~~ rounding method, Round (x), which is explained in 2.2. ~~where numbers larger than or equal to [J−0.5] and less than [J+0.5] are rounded to J as any integer number.~~

Note 2: The above table was obtained using the procedure shown below to calculate numbers of prepackages (N_{T1}, N_{T2} and N_{T1+T2}) contained in the inspection lot. ~~Where "round" means a normal rounding method explained in Note 1,~~ The functions ~~"~~NormsDist~~"~~ (Z) ~~means normal cumulative distribution function~~ and ~~"~~NormsInv~~"~~ (P) are explained in 2.2. ~~means inverse normal cumulative distribution function.~~

N_{T1} = Round [N {H_{T1+T2} – NormsDist (2 NormsInv (H_{T1+T2}))}]

N_{T2} = Round [N NormsDist {2 NormsInv (H_{T1+T2})}]

$N_{T1+T2} = N_{T1} + N_{T2}$

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Annex A

Outline of examination procedure where sampling is used

(Informative)

A.1 General

This outline may be used to develop test procedures for checking the quantity of product in prepackages by means of drawing samples from an inspection lot to ensure compliance with Clause 3 "*Metrological requirements for prepackages*".

Note: Where the full production lot is tested (sampling not carried out) the requirements of Clause 3 are applied without the need for any correction as is the case with sampling.

A.2 Procedure

A.2.1 Define the inspection lot according to 4.2.1 and 4.4.

A.2.2 Determine a sample size appropriate for the inspection lot using Table 2.

A.2.3 Determine the tolerable deficiency *T* appropriate for the nominal quantity of the prepackages according to Table 1.

A.2.4 Determine the number of prepackages allowed to have *T1* errors from column 3 of Table 2.

A.2.5 Measure (see Notes 1 and 2 below) and record the *AGM* for each prepackage to be opened for tare determination. Determine the *ATM* using the procedures in Annex B.

Note 1: This step is followed only when gravimetric non-destructive testing is used.

Note 2 Packages with protective gas or vacuum packages shall be opened before weighing to determine the *AGM*.

A.2.6 Measure and record the *AGM* of the remaining prepackages in the sample and determine the e_i for all prepackages in the sample using either A.2.6.1 or A.2.6.2 below.

A.2.6.1 If gravimetric non-destructive testing is used:

a) Calculate the *CGM* that may be used for computing e_i as follows (see Note 1):

CGM = Average Tare Mass + Nominal Quantity (in mass) of prepackage (see Note 2).

b) Determine e_i by subtracting the *CGM* from the *AGM* of each prepackage.

$$e_i = AGM - CGM$$

Note 1: This method is only a recommendation, any accurate method of computing individual prepackage errors is acceptable. The method used shall be recorded in the test report.

Note 2: When gravimetric testing is used to determine the actual quantity of fluids in prepackages labeled in units of volume, the nominal mass of liquid product in the prepackage is the nominal volume multiplied by the density of a measured volume of the liquid at a reference temperature. The internationally recommended temperature is 20 °C for the volume declaration of liquids that are not frozen.

Note 3: When gravimetric testing is used to determine the actual quantity of fluids in prepackages labeled in units of volume and the test is related to masspieces (M_w in g) of a density of 8.0 g/mL, a quantity of product expressed in units of volume (q_i in mL) should be calculated using the formula below:

$$q_i = (M_w \times 0.99985) / (\rho - 0.0012)$$

A.2.6.2 When destructive testing is used (*CGM* is not required), determine the actual quantity of the product q_i and then calculate the individual prepackage error as:

$$e_i = q_i - Q_{nom}$$

A.2.7 Determine if the test results meet the individual prepackage requirement according to the requirements of A.2.7.1 to A.2.7.4 inclusive.

A.2.7.1 Identify all prepackages in the sample with $e_i < 0$.

A.2.7.2 For these prepackages, are there any with $e_i < -2T$? If so, the lot shall be rejected.

A.2.7.3 For these prepackages, count the number with $e_i < -T$. If this number is larger than the value in column 3 of Table 2, the lot shall be rejected.

A.2.7.4 All other prepackages meet the individual prepackage requirement.

A.2.8 Determine if the test results meet the average prepackage requirement according to the requirements of A.2.8.1 to A.2.8.3 inclusive.

A.2.8.1 Calculate ~~E_{ave}~~e_{ave}, by summing the individual prepackage errors e_i obtained in A.2.6.1 or A.2.6.2, as applicable, and dividing the sum by the sample size n. If ~~E_{ave}~~ e_{ave} is 0 or a positive number, the average rule is satisfied and there is no need to proceed to A.2.8.2.

A.2.8.2 Determine the standard deviation of the individual prepackage errors of the sample using the formula:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (e_i - e_{ave})^2}{n-1}}$$

Note: This can be achieved by the following method:
For each individual prepackage in the sample calculate $d_i^2 = (e_i - $ ~~E_{ave}~~$e_{ave})^2$. Sum up the d_i^2 and divide the sum by $(n-1)$ to obtain s^2. Determine the sample standard deviation s by calculating the square root of s^2.

A.2.8.3 From the formula $\frac{e_{ave}}{s} + SCF < 0$,

calculate the quantity $\frac{e_{ave}}{s} + SCF$,

where SCF is taken from column 4 of Table 2 or calculated as defined in 2.1.~~13~~15. If this is negative reject the lot, otherwise accept.

A.3 Additional resources for test methods

For examples of test methods for a wide variety of products in different prepackages, see the following articles or OIML publications:

1 Russing, J.: Special methods for testing of certain types of prepackages such as sparkling beverages, aerosols, ice cream (OIML Bulletin - Number 96, September 1984).

2 OIML G 14:2011: *Density measurement*

Annex B
Tare procedures
(Informative)

B.1 General

These procedures permit the use of either used or unused packing material to determine the actual quantity of product in the prepackage as follows:

$$Q_i = AGM - ATM$$

B.2 Terminology

B.2.1
u~~U~~nused dry tare

mass of unused packing material of one prepackage

B.2.2
u~~U~~sed dry tare

packing material that has been used as part of a prepackage and that has been separated from the product and completely cleaned to approximate the state of the packing material when new

B.3 Procedure

B.3.1 Randomly select a tare sample of 25 packing materials from either the sample of prepackages taken from an inspection lot (used dry tare) or selected from new packing materials at the point-of-pack (unused dry tare).

Note: In the case of used dry tare determine the gross mass of the prepackage before opening the packing material (see A.2.5).

B.3.2 Where used dry tare will be used, clean the packing material in the sample by using normal household procedures used by consumers of the product. The packing material should not be dried in an oven.

B.3.3 Determine the mass of 10 of the selected packing materials in the sample.

B.3.4 Determine the *ATM* of the 10 tare samples weighed in B.3.3 and proceed as per B.3.4.1 to B.3.4.3.

B.3.4.1 If the *ATM* is equal to or less than 10 % of the nominal quantity of the product then use the *ATM* to determine the actual quantity of product in the prepackages according to the applicable requirements in A.3. If the *ATM* exceeds 10 % of the nominal quantity of product determine the sample standard deviation *s* of the initial sample and proceed to B.3.4.2 or B.3.4.3, as applicable.

B.3.4.2 If the *ATM* is greater than 10 % of the nominal quantity and *s* is equal to or less than $0.25 \times T$, use the additional 15 samples of packing materials selected in B.3.1 and weigh as in

B.3.3. Determine the combined average of the 25 samples of packing materials. Use this *ATM* of 25 packing materials to determine the actual quantity of product in the prepackages according to the applicable requirements in A.2.

B.3.4.3 If the *ATM* is greater than 10 % of the nominal quantity and *s* is greater than 0.25 × *T* of the product the *ATM* cannot be used and it is necessary to determine and to consider every individual tare mass (destructive testing). Open the prepackages and determine the actual quantity of product in each prepackage according to the applicable requirements in A.2.

Annex C
Drained quantity of products packed in liquid medium
(Informative)

C.1 General

C.1.1 This procedure may be used to determine the drained quantity of product in a liquid medium and may be applied to prepackages with nominal quantities up to 50 kg.

C.1.2 The drained quantity requirements apply to food products packed in the following **liquid mediums**, either singly or in combination, which are regarded as packing material and shall not be included as part of the nominal quantity of the product:

a) water;
b) aqueous solutions of salt (brine);
c) aqueous solutions of sugars or other sweetening substances;
d) fruit or vegetable juices in canned fruit or vegetables only;
e) vinegar.

C.2 Test apparatus

C.2.1 For draining the product from a prepackage, use a flat sieve with a square mesh of 2.5 mm and a wire thickness of 1.0 mm and drip pans. The diameter of this sieve should be 20 cm for use with prepackages where the container has a capacity of 850 mL or less, and 30 cm for use with containers of capacity exceeding 850 mL. If the declared drained mass is 2.5 kg or more, the quantity may, after weighing the whole amount, be divided among several sieves.

Note: For standardized sieves see ISO 3310-1 *Test Sieves - Technical Requirements and Testing – Part 1: Test sieves of metal wire cloth*.

C.2.2 For determination of quantity, a weighing instrument shall meet the requirements of 4.1.3.

C.3 Procedure for determining the actual quantity of the solid component of the product

C.3.1 Apply the requirements of Clause 3 "*Metrological requirements for prepackages*".

C.3.2 Select a sample of prepackages in accordance with 4.2. Sampling shall be performed when the products are ready to be marketed according to the packer, when distribution has taken place or at any time later than 30 days after sterilization, pasteurization or similar process.

C.3.3 Store the samples for a period of 12 hours before testing within the temperature range specified by the packer or between 20 °C to 24 °C.

C.3.4 Determine the mass of the empty sieve.

C.3.5 Open the prepackage and pour the product and liquid medium across the sieve. Distribute the product and liquid medium over the surface of the sieve but do not shake the material on the sieve. Tilt the sieve to an angle of 17° to 20° from the horizontal to facilitate draining.

C.3.6 Carefully invert by hand all solid product, or parts thereof, which have hollows or cavities (e.g. sliced fruit) if they fall on the sieve with hollows or cavities facing upwards.

C.3.7 Allow a 2 minute drain time.

C.3.8 Reweigh the sieve plus contents and calculate the drained mass of the product as follows:

$$M = M_{e2} - M_{e1}$$

where: M = drained mass of the product
M_{e1} = mass of the clean sieve
M_{e2} = mass of the sieve plus product after draining

C.3.9 Before the subsequent weighing of the same sieve ensure that it is clean and free of product debris. The sieve does not have to be dry as long as it is weighed accurately before being used.

Annex D
Test procedures for determining the actual quantity of frozen products

(Informative)

D.1 General

D.1.1 The requirements of Clause 3 *Metrological requirements for prepackages* are applicable to the inspection lots of prepackages measured after removing excess ice (packing material) according to the procedures in D.3 to D.5.

Note: It is not the intention to thaw the product but only to remove excess ice; the product itself should remain frozen to prevent the loss of moisture naturally contained in the product.

D.1.2 When a product not mentioned in D.3 to D.5 is enclosed in a layer of ice or has any excess ice within it or on its surface, the procedures in D.3 to D.5 may be suitably adapted or methods used to remove the excess ice which will achieve an equivalent result and are acceptable in national legislation, may be used.

D.2 Test apparatus

D.2.1 20 cm and 30 cm diameter sieves with 2.5 mm square wire mesh size and wire thickness of 1.0 mm and drip pans.

Note: For standardized sieves see ISO 3310-1 *Test Sieves - Technical Requirements and Testing* - Part 1: *Test sieves of metal wire cloth*.

D.2.2 For determination of quantity, a weighing instrument shall meet the requirements of 4.1.3.

D.2.3 Water bath of a size suitable to immerse the prepackage or a wire mesh basket containing the ice glazed product and capable of maintaining water temperature of 20 ºC and 26 ºC within an accuracy of ± 1 ºC.

D.2.4 Cold water spray.

D.2.5 Wire mesh basket large enough to hold the content of an ice glazed product and with mesh size small enough to retain the product.

D.3 Frozen fruits and vegetables

D.3.1 Determine the mass of the sieve and the drip pan to be used. For prepackages with a nominal quantity up to and including 1.4 kg use a 20 cm diameter sieve, or use a 30 cm diameter sieve for prepackages with a nominal quantity greater than 1.4 kg.

D.3.2 Immerse the prepackage in a water bath maintained at 20 ºC ± 1 ºC. If the prepackage is not water-tight, place it in a plastic bag and remove any excess air using a vacuum and then seal it securely. When all of the excess ice has melted, remove it from the water bath and wipe it dry. Open the prepackage with care and a minimum of agitation.

D.3.3 Transfer the product to the pre-weighed sieve. With the sieve tilted approximately 17° to 20° from the horizontal to facilitate drainage, distribute the product evenly over the sieve in one sweeping motion. Drain for 2 minutes then transfer the sieve containing the product to the

preweighed drip pan and determine the actual mass of the product on a suitable weighing instrument (See D.2.2).

D.3.4 Repeat D.3.1 to D.3.3 for each prepackage in the sample.

D.4 Glazed seafood and glazed poultry (product that is covered with a film of ice to preserve its quality) and blocks of frozen fish (see CODEX STAN 165 - 1989)

D.4.1 Determine the mass of the sieve and the drip pan to be used. For prepackages with a nominal quantity up to and including 900 g use a 20 cm diameter sieve, or use a 30 cm diameter sieve for prepackages with a nominal quantity greater than 900 g.

D.4.2 Remove the product from the packing material. Place it in a wire mesh basket large enough to hold the contents of the prepackage and with openings small enough to retain the product. Place the wire mesh basket containing the product under a gentle spray of cold water until the ice glaze is removed. Agitate the product with care to avoid damage.

D.4.3 Transfer the product to the pre-weighed sieve. Incline the sieve to approximately 17° to 20° from the horizontal to facilitate drainage without shifting the product. Drain for 2 minutes and then transfer the sieve with the product to the pre-weighed drip pan. Determine the actual mass of product on a suitable weighing instrument (See D.2.2).

D.4.4 Repeat D.4.1 to D.4.3 for each prepackage in the sample.

D.5 Frozen shrimp and crabmeat

D.5.1 Determine the mass of the sieve and the drip pan to be used. For prepackages with a nominal quantity up to and including 450 g use a 20 cm diameter sieve, or use a 30 cm diameter sieve for prepackages with a nominal quantity greater than 450 g.

D.5.2 Remove the product from the packing material and place in a wire mesh basket large enough to hold the contents of the prepackage and with openings small enough to retain the product. Immerse the basket containing the product in a water bath maintained at 26 ºC ± 1 ºC with a continuous water flow so that the top of the basket extends above water level. When all of the excess ice has melted, remove it from the water bath.

D.5.3 Transfer the product to the pre-weighed sieve. Incline the sieve to approximately 17° to 20° from the horizontal to facilitate drainage without shifting the product. Drain for 2 minutes and then transfer the sieve with the product to the pre-weighed drip pan. Determine the actual mass of product on a suitable weighing instrument.

D.5.4 Repeat D.5.1 to D.5.3 for each prepackage in the sample.

Annex E
Prohibition of misleading prepackages

(Informative)

E.1 General requirements

A prepackage may not have a shape, size or any feature that may mislead or deceive a consumer as to the actual quantity contained in such prepackage. This includes a false bottom, sidewalls, lid or other covering. A prepackage may not be constructed or filled in such a way that may mislead or deceive a consumer.

E.2 Complete filling

A prepackage may not be partially filled in such a way that may deceive a consumer unless the difference between the actual volume of the packing material and the volume of the product it contains (slack fill) is required in the production process. If a consumer cannot fully view the product in a prepackage it may be considered to be filled. A prepackage with excessive nonfunctional slack fill (slack fill that is not required by any production process) is considered to be a misleading one.

E.3 Functional slack fill

Reasonable slack fill may serve a necessary function for the following reasons which should not be regarded as misleading:

a) protection of the product;
b) the requirements of machines used for enclosing the contents of the prepackage;
c) unavoidable product settling during shipping and handling; and
d) the need for the prepackage to perform a specific function (e.g. where packaging plays a role in the preparation or consumption of a food), where such a function is inherent in the nature of the product and is clearly communicated to consumers.

E.4 Aerosol dispensers

The fill level of aerosol dispensers may be in accordance with national requirements or recognized industry standards specified in national requirements.

Annex F
Basis for statistical sampling model used
(Informative)

F.1 Introduction

This Appendix gives the probabilistic and statistical assumptions and reasons that underpin the acceptance sampling presented in this Recommendation. Section F.2 of this Annex derives the probability distribution of a prepackage sampled from an acceptable lot. The two lot requirements, the average and the individual, taken together determine both the mean and the standard deviation of a prepackage sampled from such a lot. Finally, section F.4 describes calculation of the values in Table 2.

Note: Several reports, namely Sim [2], Willink [3], and Field [4], pointed out that OIML R 87:2004 contained imprecise and hard to interpret statements of the lot testing requirements, and also some errors in calculation. Specifically, both Sim and Willink pointed out that the 2004 version contained errors in 4.2, Table 2, in that the sample sizes and the acceptable number of prepackages with *T1* errors did not guarantee the probability of rejecting an unacceptable lot being at least 0.9. Willink also noted that OIML R 87 did not use the requirement that there are no *T2* errors in the sample in the probability calculations. This Annex attempts to correct this situation by giving the probabilistic and statistical assumptions and reasoning that underpin the acceptance sampling presented in this Recommendation.
Section 2 of this Annex derives the probability distribution of a prepackage sampled from an acceptable lot. The two lot requirements, the average and the individual, taken together determine both the mean and the standard deviation of a prepackage sampled from such a lot (this fact was not noted in OIML R 87:2004). Finally, section 4 describes the correct calculation of the values in Table 2.

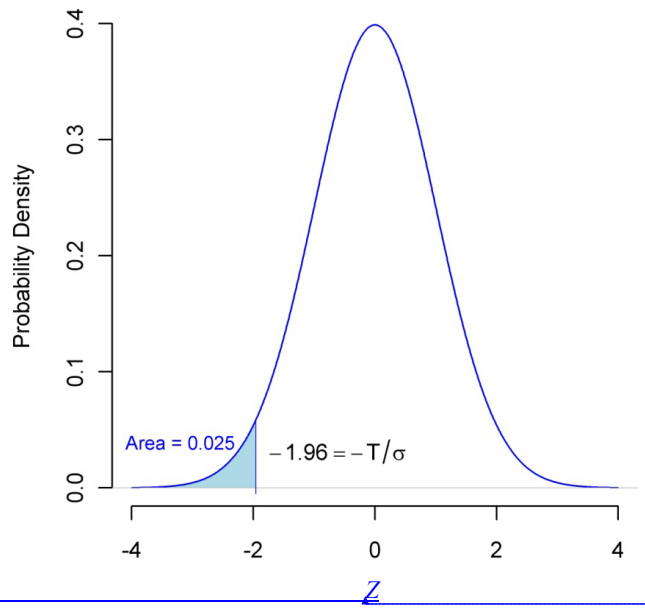
F.2 Sampling from an acceptable lot

An acceptable lot satisfies the requirement that

a) the mean μ is greater than or equal to Q_{nom}, and that
b) the percentage of prepackages in the lot with $Q_i < Q_{\text{nom}} - T$ is no greater than 2.5 %.

Consider a lot with $\mu = Q_{\text{nom}}$ and the percentage of prepackages in the lot with $Q_i < Q_{\text{nom}} - T$ being equal to 2.5 %. If we assume that a randomly selected prepackage from such a lot has a value Q_i which follows a normal distribution, then these two properties uniquely determine the mean and standard deviation of the normal distribution. The graph below illustrates this fact. It shows that such a normal curve is centered at Q_{nom} and its standard deviation is obtained by solving the equation $\frac{(Q_{\text{nom}} - T) - Q_{\text{nom}}}{\sigma} = \frac{-T}{\sigma} = -1.96$.

Figure 1 – Graphical representation of a normal density with $\mu = Q_{nom}$, and percentage of observations $Q_i < Q_{nom} - T$ equal to 2.5 %



Thus an acceptable lot is one whose sampled packages have values Q_i which are sampled from a $N\left(\mu \geq Q_{nom}, \sigma^2 \leq \left(\frac{T}{1.96}\right)^2\right)$ density.

F.3 Test of average requirement

Derivation of the test of section 4.3.1.

A statistical test satisfying the requirement given in 4.2.1 a) can be stated as:

Reject the lot if $e_{ave} < C$ for a constant C found to satisfy the requirement that the probability $P\left(e_{ave} < C\right) = 0.005$ when the prepackages are sampled from a lot with $\mu = Q_{nom}$ and standard deviation σ.

For a sample of size *n,* sampled from a lot of size *N* without replacement, the average error is distributed approximately as $e_{\text{ave}} \sim N\left(0, \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)\right)$, where the factor $\frac{N-n}{N-1}$ is the finite population correction factor. Now e_{ave} can be converted to a student's *t* density with $n-1$ degrees of freedom as

$$P\left(e_{\text{ave}} < C\right) = P\left(\frac{e_{\text{ave}}}{s\sqrt{\frac{(N-n)}{n(N-1)}}} < \frac{C}{s\sqrt{\frac{(N-n)}{n(N-1)}}}\right) = P\left(t_{n-1} < \frac{C}{s\sqrt{\frac{(N-n)}{n(N-1)}}}\right).$$

The requirement that $P\left(e_{\text{ave}} < C\right) = 0.005$ then becomes the requirement that

$P\left(t_{n-1} < \frac{C}{s\sqrt{\frac{(N-n)}{n(N-1)}}}\right) = 0.005$, and since $P\left(t_{n-1} < t_{0.005,n-1}\right) = 0.005$, we obtain

$$t_{0.005,n-1} = \frac{C}{s\sqrt{\frac{N-n}{n(N-1)}}}.$$

This leads to the result that $C = st_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}}$, giving the test

Reject the lot if $\frac{e_{\text{ave}}}{s} < t_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}}$

where the quantity

$$-t_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}}$$

is equivalent to *SCF* (Sample Correction Factor) defined in 2.1.~~13~~15.

This test is constructed so that it guarantees the probability requirement of 4.2.1 a).

The test also needs to satisfy a second requirement, that is, that it achieves probability of rejection of 0.9 for unacceptable lots with $\mu < Q_{\text{nom}} - 0.74\sigma$ where σ is the standard deviation of the lot. For the lot and sample sizes given in Table 2 this is satisfied.

Suppose that for the lot being tested, $\mu = Q_{\text{nom}} - 0.74\sigma$. Then $e_{\text{ave}} \sim N\left(-0.74\sigma, \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)\right)$.

So the requirement in 4.2.1 a) states that $P\left(e_{\text{ave}} < st_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}}\right) \geq 0.9$, and converting to a student *t* density as above we obtain

$$P\left(e_{\text{ave}} < st_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}}\right) = P\left(t_{n-1} < \frac{st_{0.005,n-1}\sqrt{\frac{N-n}{n(N-1)}} + 0.74\sigma}{s\sqrt{\frac{N-n}{n(N-1)}}}\right) \cong$$

$$P\left(t_{n-1} < t_{0.005,n-1} + 0.74\sqrt{\frac{n(N-1)}{N-n}}\right) \geq 0.9$$

and since $P\left(t_{n-1} < t_{0.9,n-1}\right) = 0.9$, we conclude that the requirement is satisfied if

$$\sqrt{\frac{n(N-1)}{N-n}} \geq \frac{t_{0.9,n-1} - t_{0.005,n-1}}{0.74}.$$

For each *N* and *n* in Table 2 we can show that this inequality holds and so the requirement is satisfied.

Note: This inequality is derived using the approximation that $s \cong \sigma$. As *s* is a consistent estimator of σ, this approximation is increasingly better as the sample size increases. More exactly we note that $\frac{(n-1)s^2}{\sigma^2}$ is distributed as a chi-square random variable with $n-1$ degrees of freedom. Using this additional information, we can show that for all *N* and *n* in Table 2 the inequality is still satisfied with probability that approaches 1 as *N* increases. Even for the smaller sample sizes, for example for $n = 47$, $N = 80$, this probability is 0.999.

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F.4 Test of individual requirement

Calculation of the values in Table 2.

The test of the individual requirement is done using the statistics n_{T1} and n_{T2}. These two statistics follow a multivariate hypergeometric distribution [5], that is, their density is defined as

$$P(n_{T1}, n_{T2}) = \frac{\binom{N_{T1}}{n_{T1}}\binom{N_{T2}}{n_{T2}}\binom{N - N_{T1} - N_{T2}}{n - n_{T1} - n_{T2}}}{\binom{N}{n}}, \text{ where } \binom{a}{b} = \frac{a!}{b!(a-b)!}.$$

N_{T2} is the number of prepackages in the lot with *T2* errors. N_{T1} is the number of prepackages in the lot for which $-2T \leq E_i < T$. This probability distribution is a generalization of the hypergeometric density used in [2], it is required in order to account for the fact that in addition to the criteria based on n_{T1}, the lot may be rejected on the basis of n_{T2}. The need to take this into account was also noted

by [3].

1. When a package is sampled from an acceptable lot, we showed above that the values Q_i follow $N\left(Q_{nom}, \left(\frac{T}{1.96}\right)^2\right)$ distribution.

Now, given the size of the lot N, $N_{T2} = N * P(Q_i < Q_{nom} - 2T) = N * P(Z < 3.92) \approx N * 0 = 0$.

Then $N_{T1} = 0.025 * N$.

Now for a particular choice of n and these N_{T1} and N_{T2} we require that

$$P\left(n_{T1} \le k_1, n_{T2} = 0\right) = 0.95.$$

2. Suppose that a package is sampled from a lot with $N_{T1} + N_{T2}$ being 9 % of the lot size N. It is required that such a lot be rejected with probability 0.9. This means that for such a lot it is required that $P\left(n_{T1} \le k_1, n_{T2} = 0\right) = 0.1$.

In order to be able to calculate this probability we need to have N_{T2} and we know that

$$N_{T2} = N * P\left(Q_i < Q_{nom} - 2T\right).$$

To facilitate making this probability calculation we need to make an assumption about the mean μ. The most conservative choice (the hardest to detect unacceptable lot is one with the correct mean but too many *T1* errors) is to have $\mu = Q_{nom}$.

For this choice, using the same kind of arguments as in section F.2, $Q_i \sim N\left(Q_{nom}, \left(\frac{T}{1.34}\right)^2\right)$ and so

$$P\left(Q_i < Q_{nom} - 2T\right) = P\left(Z < -2.68\right) = 0.0037.$$

Thus $N_{T2} = N * 0.0037$ and $N_{T1} = 0.09 * N - 0.0037 * N = 0.0863 * N$.

3. For a given lot size N we now find the sample size n and the value k_1 such that for $N_{T1} = 0.025 * N$ and $N_{T2} = 0$, $P\left(n_{T1} \le k_1, n_{T2} = 0\right) = 0.95$, and for $N_{T1} = 0.0863 * N$ and $N_{T2} = 0.0037 * N$, $P\left(n_{T1} \le k_1, n_{T2} = 0\right) = 0.1$. These values are given in Table 2.

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Annex G
Schematic representation for the application of *T1* and *T2* errors

(Informative)

Figure 1 gives a schematic representation of the application of *T1* and *T2* errors as defined in 2.1.2.3 and 2.1.2.4 respectively.

Figure 1 – Example of *T1* and *T2* Errors for T = 4.5 g

<table>
<tr><td></td><td>100 g</td><td colspan="2">Nominal quantity (Q_{nom})</td></tr>
<tr><td rowspan="3">Individual package errors (E_i)
(inadequate prepackage)</td><td>$-T \le E_i < 0$
$-4.5\text{ g} \le E_i < 0$</td><td colspan="2">Individual package quantities Q_i less than Q_{nom} but equal to or greater than ($Q_{nom} - T$) are acceptable variations.</td></tr>
<tr><td>$-2T \le E_i < -T$
$-9\text{ g} \le E_i < -4.5\text{ g}$</td><td>↑
T1
Error
↓</td><td>Individual package errors less than $-T$ but equal to or greater than $-2T$ are called *T1* errors.</td></tr>
<tr><td>$E_i < -2T$
$E_i < -9\text{ g}$</td><td>↑
T2
Error
↓</td><td>Individual package errors less than $-2T$ are called *T2* errors.</td></tr>
</table>

Annex H
Stepwise sampling plan
(Informative)

H.1 Introduction

In the revision process of OIML R 87:2004 some Member States requested the addition of a more practical sampling method for legal metrology officials that would enable testing with a smaller sample size. However, a simple decrease in the sample size might cause an increase in the probability of a false judgment. In order to respond to such request, a stepwise sampling plan was introduced in this Annex. The procedures proposed by this plan may be adopted in support of OIML R 87 based on a requirement from the authority in each Member State or Region.

H.2 Inspection requirements specified in R 87

R 87 stipulates seven important and statistical criteria on which an inspection lot is accepted (or rejected) when a total inspection method or a sampling method is used. A summary of the criteria is shown in **Table H.1**.

Table H.1 – Inspection requirements specified in R 87

Method of inspection	No.	Kind of criteria		Numerical criteria or characteristics	Probability for accepting the lot	Relevant clauses in R 87
Total inspection*1	1	Average		$Q_{ave} \geq Q_{nom}$ *3	No need for consideration*1	3.2
	2	Individual		$H_{T1} \leq 2.5$ % and $N_{T2} = 0$ *3		3.3
Sampling inspection*2	3	Average	PR*5	$Q_{ave} \geq Q_{nom}$ *3	$P_{ac} > 99.5$ %	4.2.1 a) and 4.3.1
	4		CR*5	$Q_{ave} < Q_{nom} - 0.74\sigma$ *4	$P_{ac} < 10$ %	
	5	Individual	PR*5	$H_{T1} \leq 2.5$ % *3	$P_{ac} > 95$ %	4.2.1 b) and 4.3.2 a)
	6		CR*5	$H_{T1} \geq 9$ % *4	$P_{ac} < 10$ %	4.2.1 b) and 4.3.2 b)
	7			$n_{T2} = 0$	No need for consideration	4.3.3

*1 In the total inspection method, all prepackages of an inspection lot are measured. In this

method, both criteria 1 and 2 shall be met in order that the inspection lot would be accepted. In this case, the acceptance of the lot will be decided clearly, and there is no need to consider a probability because P_{ac} becomes 100 % if all criteria be met and it becomes 0 % otherwise.

∗2 For the sampling inspection method, an inspection method shall be selected or planned in order that all of the criteria 3-7 would be met. In this method, an inspection lot with the specified numerical characteristics shall be accepted under the specified criteria of probabilities (P_{ac}).

*3 These numerical criteria are set in order that an adequate inspection lot would be accepted with a probability more than the specified values (P_{ac}). In the sampling method however, these criteria are confirmed indirectly based on the inspection result of the sample.

*4 These characteristics are set for an inadequate inspection lot to be tested, and this lot shall be accepted with a probability less than the specified values (P_{ac}). In other words, this lot shall be rejected in order to ensure that the consumer's risk becomes less than the specified probability (P_{ac}).

*5 PR indicates criteria to reduce the producer's risk and CR indicates criteria to reduce the consumer's risk.

H.3 Test procedure for the stepwise sampling method

This clause explains the stepwise sampling method based on the average and individual requirements specified in Clauses 3 and 4 of R 87. This method requires that a test be conducted for the individual requirement (H.3.1) initially and only if this requirement is satisfied, then requires another test for the average requirement (H.3.2). Both tests shall be satisfied in order for an inspection lot to be accepted.

H.3.1 Test procedures for individual prepackage requirements

Practical test procedures for the individual requirements (Criteria 5 to 7 of **Table H.1**) are given below. They are also illustrated using flow charts in **Figures H.1 to H.4**.

H.3.1.1 Identify the inspection lot to be tested.

H.3.1.2 Find out the nominal quantity (Q_{nom}), and decide the tolerable deficiency to be applied to prepackages in the lot using **Table 1 in R 87**.

H.3.1.3 Decide (or find out) the size of the inspection lot (N) based on the requirements in 4.4. Find the maximum value of the sample size (n), which might be required throughout all the sampling steps, from **Table H.2**. A case with N = 100–139 and n = 75 (at step 4) is employed in the following explanations.

H.3.1.4 Take **75** prepackages randomly from the inspection lot and mark them with **identification numbers** (#1 to #75). This group of 75 items is referred to as the **'original sample'** in these procedures. This procedure is necessary in order to maintain randomness in sampling and not to repeat measurements on the same item.

~~H.3.1.4~~H.3.1.5 In the procedures H.3.1.6 to H.3.1.9, the inspection lot shall be **rejected immediately** if there is **one** prepackage with ***T2*** error, or **four or more** prepackages with ***T1*** errors.

~~H.3.1.5~~H.3.1.6 **STEP 1**: Take a small group of **35** prepackages (#1 to #35) from the original sample and measure the actual quantity in each. After the measurements, do not mix the measured 35 prepackages with the rest. Then, count the number of prepackages with *T1* and *T2* errors. If there is **no** prepackage with ***T1*** error among the 35 (note that n_{T1} = 0 at step 1 in **Table H.2**), the individual requirement is satisfied (go to H.3.2). If there are **one, two or three** prepackages with *T1* errors, go to procedures H.3.1.~~6~~7, H.3.1.~~7~~ 8 or H.3.1.~~8~~9, respectively.

~~H.3.1.6~~H.3.1.7 **STEP 2**: If there is **one** prepackage with ***T1*** error among the 35, take an additional small group of prepackages from the original sample up to **#50** and measure the actual quantities of the additional prepackages. If there is **no additional** prepackage with *T1* error, the individual requirement is satisfied (go to H.3.2). If there are **two or three** prepackages in total with *T1* errors, go to procedures H.3.1.~~7~~ 8 or H.3.1.~~8~~9, respectively.

~~H.3.1.7~~H.3.1.8 **STEP 3:** If there are **two** prepackages with ***T1*** errors, take an additional small group of prepackages from the original sample up to **#60** and measure the actual quantities of the additional prepackages. If there is **no additional** prepackage with *T1* error, the individual requirement is satisfied (go to H.3.2). If there are **three** prepackages in total with *T1* errors, go to procedure H.3.1.~~8~~9.

~~H.3.1.8~~H.3.1.9 **STEP 4:** If there are **three** prepackages with ***T1*** errors, take all items left in the original sample (**75 in total**) and measure the actual quantities of the additional prepackages. If there is **no additional** prepackage with *T1* error, the individual requirement is

satisfied (go to H.3.2).

~~In the procedures H.3.1.5 to H.3.1.8, the inspection lot shall be **rejected immediately** if there is **one** prepackage with ***T2*** error, or **four or more** prepackages with ***T1*** errors.~~

H.3.2 Test procedure for average requirement

Only if the test for individual requirement (H.3.1) has been passed, another test for average requirement shall be followed based on criteria 3 and 4 of Table H.1. Firstly, obtain actual numbers of lot size (N) and sample size (n) when the individual test has been passed. Then, calculate the *SCF* using the equation in 2.1.~~13~~15. *SCF* may be obtained using functions of Microsoft Excel (Version 2010 or later) as given by Equation H.1. In this calculation, the sample size (n) is equivalent to the cumulative total number of samples which were sampled practically in the stepwise procedures from H.3.1.~~5~~ 6 to H.3.1.~~8~~9.

$$SCF = -\text{T.INV}\,(0.005, n-1) \,/\, (\text{SQRT}\,(n \times (N-1) \,/\, (N-n))) \qquad \text{(H.1)}$$

Then, confirm if *SCF* meets the criterion given by the equation in 4.3.1. If this criterion is fulfilled, it is concluded that the inspection lot satisfies the average requirement.

H.3.3 Final assessment

If the inspection lot passes the individual requirement (H.3.1) as well as the average requirement (H.3.2), it shall be concluded that the lot fulfills all requirements of this Annex based on R 87, and the inspection lot should be accepted.

Table H.2 – Values of sample sizes (*n*) and acceptable prepackages with *T1* errors (n_{T1}) in the stepwise sampling method proposed in this Annex

Lot size (*N*)		Step No.	Cumulative sample size (*n*)	Acceptable number of prepackages in the sample with *T1* errors (n_{T1})
Minimum	Maximum			
100	**139**	**1**	**35**	**0**
		2	**50**	**1**
		3	**60**	**2**
		4	**75**	**3**
140	289	1	35	0
		2	50	1
		3	65	2
		4	80	3
		5	95	4
290	999	1	40	0
		2	50	1
		3	70	2
		4	90	3
		5	100	4
		6	115	5
1 000	100 000	1	40	0
		2	55	1
		3	70	2
		4	95	3
		5	105	4
		6	120	5
		7	135	6

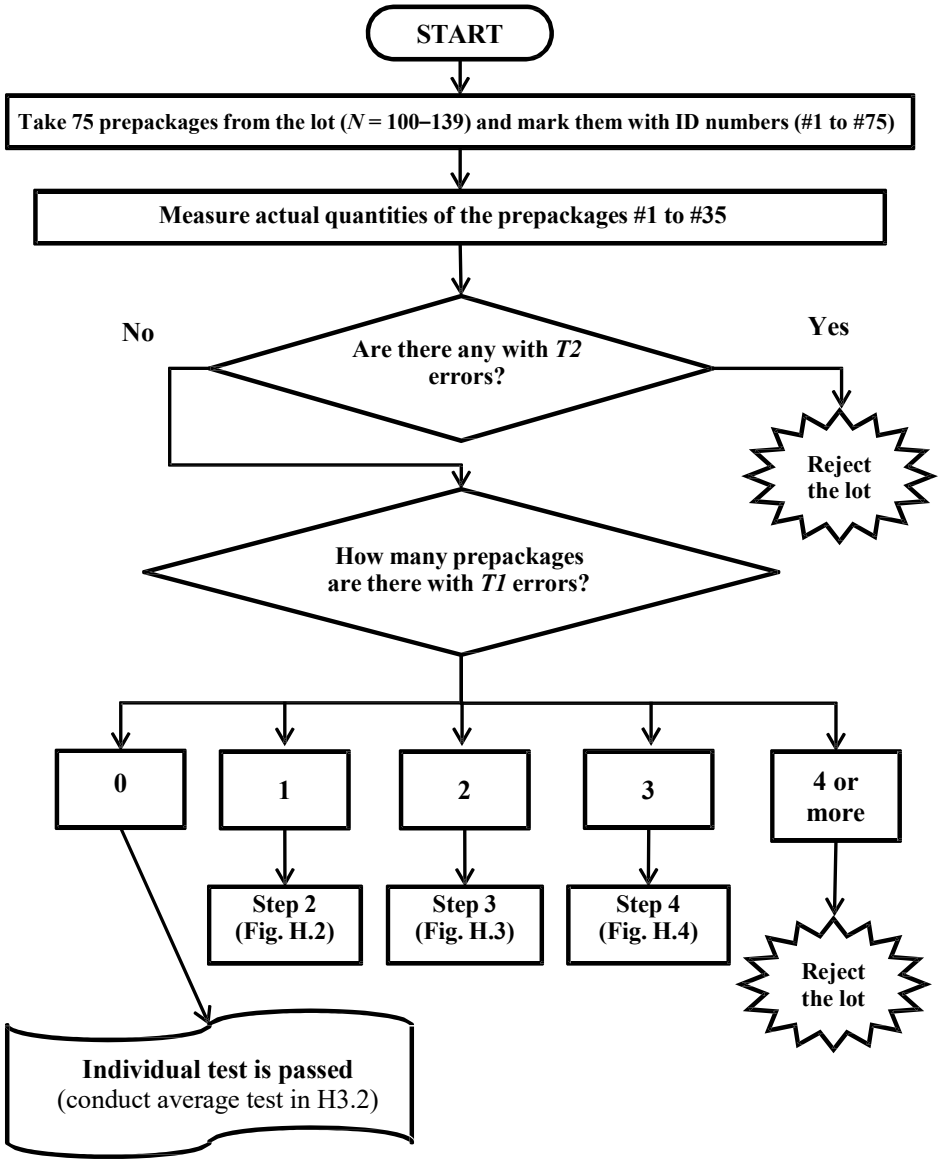

Figure H.1 Stepwise sampling method to test the individual requirement for a lot size $N = 100–139$
Step 1: Start the entire procedure

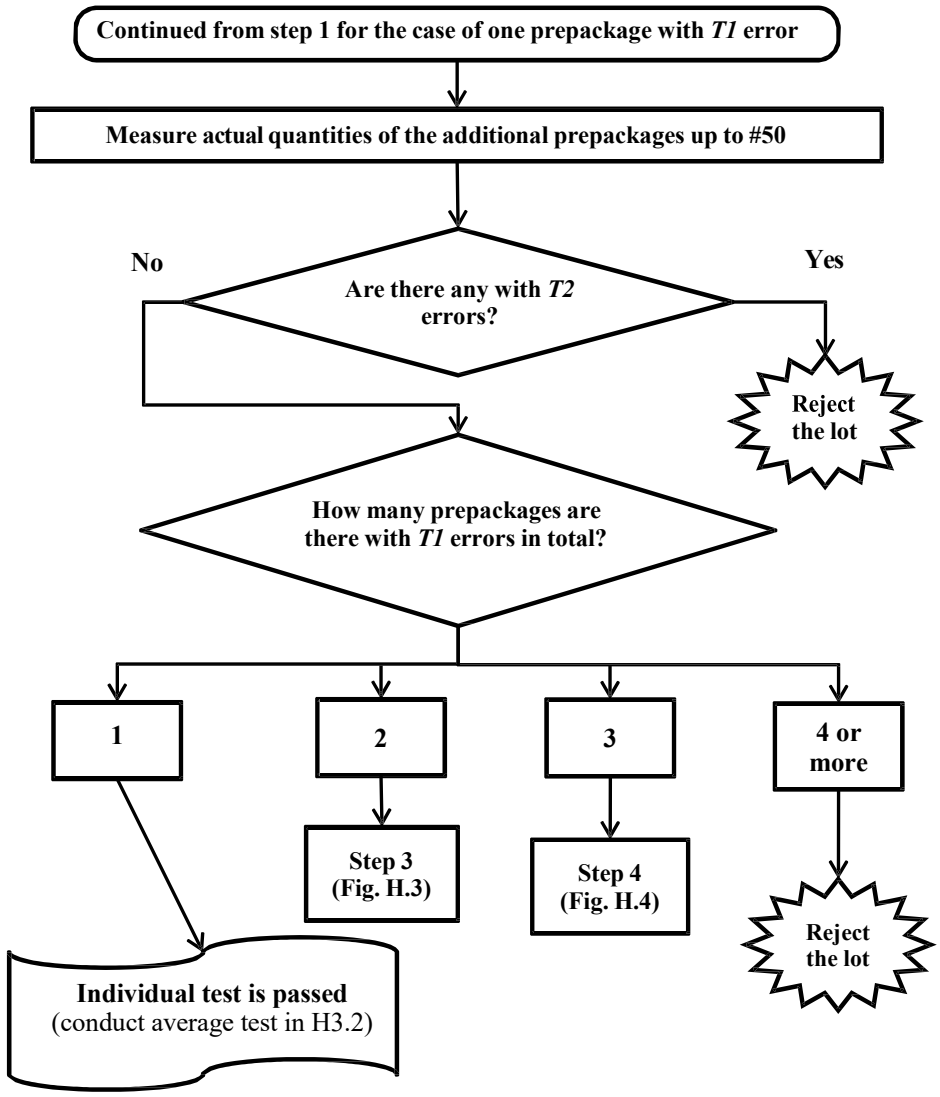

Figure H.2 **Stepwise sampling method to test the individual requirement for a lot size**

***N* = 100–139**

Step 2: A case when <u>one</u> prepackage with *T1* error was found in step 1

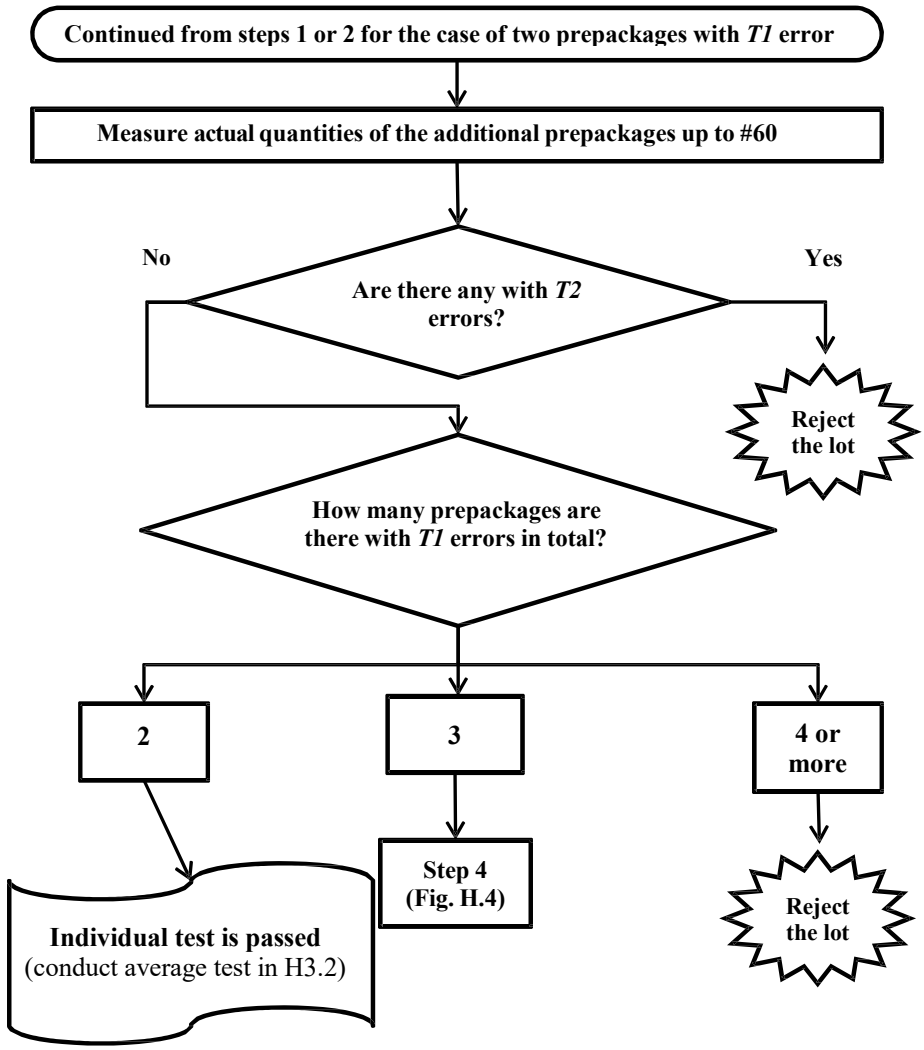

Figure H.3 Stepwise sampling method to test the individual requirement for a lot size N = 100–139

Step 3: A case when <u>two</u> prepackages with *T1* error were found in step 1 or 2

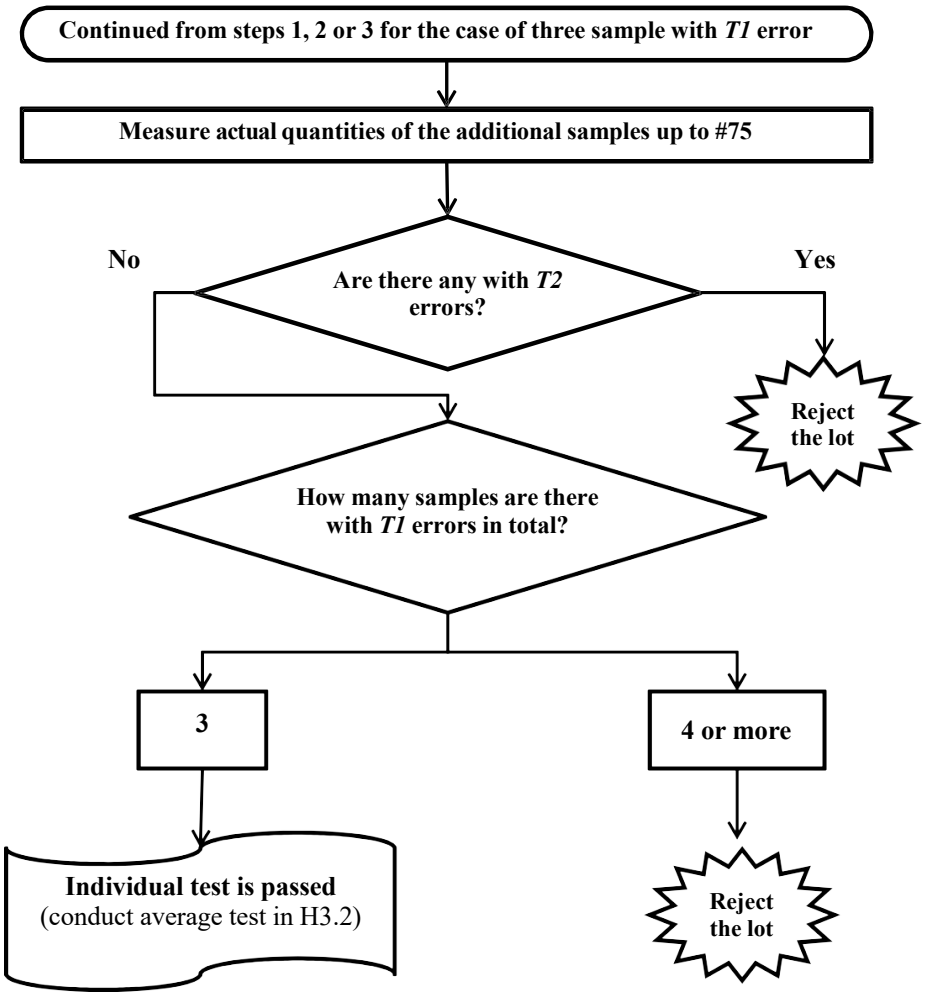

Figure H.4 **Stepwise sampling method to test the individual requirement for a lot size**

***N* = 100–139**

Step 4: A case when <u>three</u> prepackages with *T1* error were found in step 1, 2 or 3

Annex I
Detailed sampling plans

(Informative)

Series 1 (N = 21 to 310)				Series 2 (N = 311 to 599)			
Inspection lot size, *N*	**Sample size, *n***	**Number of prepackages allowed with *T1* error**	***SCF***	**Inspection lot size, *N***	**Sample size, *n***	**Number of prepackages allowed with *T1* error**	***SCF***
21	20	1	0.14	311	79	4	0.26
22	21	1	0.14	312	80	4	0.25
23	22	1	0.13	313	80	4	0.26
24	23	1	0.12	314	80	4	0.26
25	24	1	0.12	315	80	4	0.26
26	25	1	0.11	316	81	4	0.25
27	26	1	0.11	317	81	4	0.25
28	27	1	0.10	318	81	4	0.25
29	23	1	0.27	319	79	4	0.26
30	24	1	0.26	320	79	4	0.26
31	25	1	0.25	321	79	4	0.26
32	26	1	0.24	322	80	4	0.26
33	27	1	0.23	323	80	4	0.26
34	28	1	0.22	324	80	4	0.26
35	28	1	0.24	325	80	4	0.26
36	29	1	0.23	326	81	4	0.25
37	30	1	0.22	327	81	4	0.25
38	31	1	0.21	328	81	4	0.25
39	32	1	0.21	329	81	4	0.25
40	32	1	0.22	330	82	4	0.25
41	28	1	0.30	331	79	4	0.26
42	29	1	0.29	332	80	4	0.26
43	29	1	0.30	333	80	4	0.26
44	30	1	0.29	334	80	4	0.26
45	31	1	0.28	335	80	4	0.26
46	31	1	0.29	336	81	4	0.26
47	32	1	0.28	337	81	4	0.26
48	33	1	0.27	338	81	4	0.26
49	33	1	0.28	339	81	4	0.26
50	34	1	0.27	340	82	4	0.25
51	35	1	0.26	341	82	4	0.25
52	35	1	0.27	342	80	4	0.26
53	31	1	0.32	343	80	4	0.26
54	31	1	0.33	344	80	4	0.26
55	32	1	0.32	345	80	4	0.26

56	33	1	0.31	346	81	4	0.26
57	33	1	0.31	347	81	4	0.26
58	34	1	0.30	348	81	4	0.26
59	34	1	0.31	349	81	4	0.26
60	35	1	0.30	350	82	4	0.26
61	46	2	0.20	351	82	4	0.26
62	47	2	0.19	352	82	4	0.26
63	47	2	0.20	353	82	4	0.26
64	42	2	0.25	354	80	4	0.26
65	43	2	0.24	355	80	4	0.26
66	44	2	0.24	356	81	4	0.26
67	44	2	0.24	357	81	4	0.26
68	45	2	0.24	358	81	4	0.26
69	46	2	0.23	359	81	4	0.26
70	46	2	0.23	360	81	4	0.26
71	47	2	0.23	361	82	4	0.26
72	48	2	0.23	362	82	4	0.26
73	48	2	0.23	363	82	4	0.26
74	49	2	0.22	364	82	4	0.26
75	50	2	0.22	365	80	4	0.26
76	45	2	0.26	366	80	4	0.26
77	46	2	0.25	367	81	4	0.26
78	46	2	0.26	368	81	4	0.26
79	47	2	0.25	369	81	4	0.26
80	47	2	0.25	370	81	4	0.26
81	48	2	0.25	371	82	4	0.26
82	49	2	0.24	372	82	4	0.26
83	49	2	0.25	373	82	4	0.26
84	50	2	0.24	374	82	4	0.26
85	50	2	0.24	375	82	4	0.26
86	51	2	0.24	376	83	4	0.26
87	46	2	0.27	377	81	4	0.26
88	47	2	0.27	378	81	4	0.26
89	47	2	0.27	379	81	4	0.26
90	48	2	0.27	380	81	4	0.26
91	49	2	0.26	381	82	4	0.26
92	49	2	0.26	382	82	4	0.26
93	50	2	0.26	383	82	4	0.26
94	50	2	0.26	384	82	4	0.26
95	51	2	0.26	385	82	4	0.26
96	51	2	0.26	386	83	4	0.26
97	52	2	0.25	387	83	4	0.26
98	52	2	0.26	388	83	4	0.26
99	48	2	0.28	389	81	4	0.26
100	49	2	0.28	390	81	4	0.26
101	60	3	0.22	391	81	4	0.26
102	61	3	0.22	392	82	4	0.26
103	61	3	0.22	393	82	4	0.26
104	62	3	0.22	394	82	4	0.26

105	63	3	0.21	395	82	4	0.26
106	63	3	0.21	396	82	4	0.26
107	64	3	0.21	397	83	4	0.26
108	64	3	0.21	398	83	4	0.26
109	65	3	0.21	399	83	4	0.26
110	66	3	0.21	400	81	4	0.26
111	61	3	0.23	401	81	4	0.26
112	61	3	0.23	402	82	4	0.26
113	62	3	0.23	403	82	4	0.26
114	62	3	0.23	404	82	4	0.26
115	63	3	0.23	405	82	4	0.26
116	63	3	0.23	406	82	4	0.26
117	64	3	0.22	407	83	4	0.26
118	65	3	0.22	408	83	4	0.26
119	65	3	0.22	409	83	4	0.26
120	66	3	0.22	410	79	4	0.27
121	66	3	0.22	411	80	4	0.27
122	62	3	0.24	412	78	4	0.27
123	62	3	0.24	413	78	4	0.27
124	63	3	0.24	414	78	4	0.27
125	63	3	0.24	415	79	4	0.27
126	64	3	0.23	416	79	4	0.27
127	64	3	0.23	417	79	4	0.27
128	65	3	0.23	418	79	4	0.27
129	65	3	0.23	419	79	4	0.27
130	66	3	0.23	420	79	4	0.27
131	66	3	0.23	421	80	4	0.27
132	67	3	0.23	422	80	4	0.27
133	67	3	0.23	423	78	4	0.27
134	63	3	0.24	424	78	4	0.27
135	64	3	0.24	425	79	4	0.27
136	64	3	0.24	426	79	4	0.27
137	47	2	0.32	427	79	4	0.27
138	47	2	0.32	428	79	4	0.27
139	48	2	0.31	429	79	4	0.27
140	48	2	0.32	430	79	4	0.27
141	59	3	0.27	431	80	4	0.27
142	60	3	0.26	432	80	4	0.27
143	60	3	0.26	433	80	4	0.27
144	61	3	0.26	434	80	4	0.27
145	57	3	0.28	435	79	4	0.27
146	58	3	0.27	436	79	4	0.27
147	58	3	0.27	437	79	4	0.27
148	59	3	0.27	438	79	4	0.27
149	59	3	0.27	439	79	4	0.27
150	59	3	0.27	440	79	4	0.27
151	60	3	0.27	441	80	4	0.27
152	60	3	0.27	442	80	4	0.27
153	61	3	0.26	443	80	4	0.27

154	61	3	0.27	444	80	4	0.27
155	61	3	0.27	445	80	4	0.27
156	62	3	0.26	446	79	4	0.27
157	59	3	0.27	447	79	4	0.27
158	59	3	0.28	448	79	4	0.27
159	59	3	0.28	449	79	4	0.27
160	60	3	0.27	450	79	4	0.27
161	60	3	0.27	451	80	4	0.27
162	61	3	0.27	452	80	4	0.27
163	61	3	0.27	453	80	4	0.27
164	61	3	0.27	454	80	4	0.27
165	62	3	0.27	455	80	4	0.27
166	62	3	0.27	456	81	4	0.27
167	63	3	0.27	457	81	4	0.27
168	59	3	0.28	458	79	4	0.27
169	60	3	0.28	459	79	4	0.27
170	60	3	0.28	460	79	4	0.27
171	61	3	0.27	461	80	4	0.27
172	61	3	0.27	462	80	4	0.27
173	61	3	0.27	463	80	4	0.27
174	62	3	0.27	464	80	4	0.27
175	62	3	0.27	465	80	4	0.27
176	62	3	0.27	466	80	4	0.27
177	63	3	0.27	467	81	4	0.27
178	63	3	0.27	468	81	4	0.27
179	63	3	0.27	469	81	4	0.27
180	61	3	0.28	470	79	4	0.27
181	61	3	0.28	471	80	4	0.27
182	61	3	0.28	472	80	4	0.27
183	62	3	0.28	473	80	4	0.27
184	62	3	0.28	474	80	4	0.27
185	62	3	0.28	475	80	4	0.27
186	63	3	0.27	476	80	4	0.27
187	63	3	0.27	477	81	4	0.27
188	63	3	0.27	478	81	4	0.27
189	64	3	0.27	479	81	4	0.27
190	64	3	0.27	480	81	4	0.27
191	64	3	0.27	481	80	4	0.27
192	61	3	0.28	482	80	4	0.27
193	62	3	0.28	483	80	4	0.27
194	62	3	0.28	484	80	4	0.27
195	62	3	0.28	485	80	4	0.27
196	63	3	0.28	486	80	4	0.27
197	63	3	0.28	487	81	4	0.27
198	63	3	0.28	488	81	4	0.27
199	64	3	0.27	489	81	4	0.27
200	64	3	0.27	490	81	4	0.27

201	64	3	0.27	491	81	4	0.27
202	65	3	0.27	492	81	4	0.27
203	62	3	0.28	493	80	4	0.27
204	62	3	0.28	494	80	4	0.27
205	63	3	0.28	495	80	4	0.27
206	63	3	0.28	496	80	4	0.27
207	63	3	0.28	497	81	4	0.27
208	63	3	0.28	498	81	4	0.27
209	64	3	0.28	499	81	4	0.27
210	64	3	0.28	500	81	4	0.27
211	64	3	0.28	501	81	4	0.27
212	65	3	0.27	502	81	4	0.27
213	65	3	0.28	503	82	4	0.27
214	65	3	0.28	504	80	4	0.27
215	63	3	0.28	505	80	4	0.27
216	63	3	0.28	506	80	4	0.27
217	63	3	0.28	507	80	4	0.27
218	64	3	0.28	508	81	4	0.27
219	64	3	0.28	509	81	4	0.27
220	64	3	0.28	510	81	4	0.27
221	76	4	0.25	511	81	4	0.27
222	76	4	0.25	512	81	4	0.27
223	77	4	0.24	513	81	4	0.27
224	77	4	0.24	514	82	4	0.27
225	78	4	0.24	515	82	4	0.27
226	75	4	0.25	516	80	4	0.27
227	75	4	0.25	517	80	4	0.27
228	75	4	0.25	518	81	4	0.27
229	76	4	0.25	519	81	4	0.27
230	76	4	0.25	520	81	4	0.27
231	76	4	0.25	521	81	4	0.27
232	77	4	0.25	522	81	4	0.27
233	77	4	0.25	523	81	4	0.27
234	77	4	0.25	524	82	4	0.27
235	78	4	0.24	525	82	4	0.27
236	78	4	0.25	526	82	4	0.27
237	78	4	0.25	527	82	4	0.27
238	64	3	0.28	528	81	4	0.27
239	64	3	0.28	529	81	4	0.27
240	64	3	0.28	530	81	4	0.27
241	65	3	0.28	531	81	4	0.27
242	65	3	0.28	532	81	4	0.27
243	65	3	0.28	533	81	4	0.27
244	65	3	0.28	534	81	4	0.27
245	66	3	0.28	535	82	4	0.27
246	66	3	0.28	536	82	4	0.27

247	66	3	0.28	537	82	4	0.27
248	67	3	0.28	538	82	4	0.27
249	67	3	0.28	539	81	4	0.27
250	64	3	0.29	540	81	4	0.27
251	65	3	0.28	541	81	4	0.27
252	65	3	0.28	542	81	4	0.27
253	65	3	0.28	543	81	4	0.27
254	65	3	0.28	544	81	4	0.27
255	66	3	0.28	545	82	4	0.27
256	66	3	0.28	546	82	4	0.27
257	66	3	0.28	547	82	4	0.27
258	66	3	0.28	548	82	4	0.27
259	67	3	0.28	549	82	4	0.27
260	67	3	0.28	550	82	4	0.27
261	77	4	0.25	551	81	4	0.27
262	77	4	0.25	552	81	4	0.27
263	77	4	0.25	553	81	4	0.27
264	77	4	0.25	554	81	4	0.27
265	78	4	0.25	555	82	4	0.27
266	78	4	0.25	556	82	4	0.27
267	78	4	0.25	557	82	4	0.27
268	79	4	0.25	558	82	4	0.27
269	79	4	0.25	559	82	4	0.27
270	79	4	0.25	560	82	4	0.27
271	80	4	0.25	561	82	4	0.27
272	80	4	0.25	562	81	4	0.27
273	77	4	0.26	563	81	4	0.27
274	78	4	0.25	564	81	4	0.27
275	78	4	0.25	565	81	4	0.27
276	78	4	0.25	566	82	4	0.27
277	78	4	0.25	567	82	4	0.27
278	79	4	0.25	568	82	4	0.27
279	79	4	0.25	569	82	4	0.27
280	79	4	0.25	570	82	4	0.27
281	80	4	0.25	571	82	4	0.27
282	80	4	0.25	572	83	4	0.27
283	80	4	0.25	573	83	4	0.27
284	78	4	0.26	574	81	4	0.27
285	78	4	0.26	575	81	4	0.27
286	78	4	0.26	576	82	4	0.27
287	78	4	0.26	577	82	4	0.27
288	79	4	0.25	578	82	4	0.27
289	79	4	0.25	579	82	4	0.27
290	79	4	0.25	580	82	4	0.27
291	79	4	0.25	581	82	4	0.27
292	80	4	0.25	582	82	4	0.27

293	80	4	0.25	583	83	4	0.27
294	80	4	0.25	584	83	4	0.27
295	81	4	0.25	585	81	4	0.27
296	66	3	0.29	586	82	4	0.27
297	66	3	0.29	587	82	4	0.27
298	66	3	0.29	588	82	4	0.27
299	67	3	0.29	589	82	4	0.27
300	67	3	0.29	590	82	4	0.27
301	79	4	0.26	591	82	4	0.27
302	80	4	0.25	592	82	4	0.27
303	80	4	0.25	593	83	4	0.27
304	80	4	0.25	594	83	4	0.27
305	81	4	0.25	595	83	4	0.27
306	81	4	0.25	596	83	4	0.27
307	78	4	0.26	597	82	4	0.27
308	79	4	0.26	598	82	4	0.27
309	79	4	0.26	599	82	4	0.27
310	79	4	0.26				
Inspection lot size, *N*	**Sample size, *n***	**Number of prepackages allowed with *T1* error**	***SCF***	**Inspection lot size, *N***	**Sample size, *n***	**Number of prepackages allowed with *T1* error**	***SCF***

Annex J
References

(Informative)

[1] OIML R 79 *Labelling requirements for prepackages*

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