

## CODEX SAMPLING PLANS FOR PREPACKAGED FOODS (AQL 6.5) CODEX STAN 233-1969

### 1. SCOPE

The Sampling Plans in Appendix I of this document apply to the acceptance of **defective units (defectives)** in **lots** of prepackaged foods, as defined in individual Codex Standards, insofar as the Sampling Plans have been specifically included in such Codex Standards for the purpose of determining the acceptability or otherwise of the lot. They shall be used in accordance with the provisions dealing with the classification of **defectives** and **lot acceptance** in Codex Standards to which these Sampling Plans are stated to apply and within the limits of Section 2 of this document.

### 2. FIELD OF APPLICATION

#### 2.1 TYPE OF EXAMINATION TO WHICH THE SAMPLING PLANS APPLY

The Sampling Plans in Appendix I of this document are intended primarily to cover the **quality** provisions of Codex Commodity Standards where an AQL of 6.5 is appropriate for the defective unit as defined in Codex Standards. For the purposes of these Sampling Plans, “quality” refers to those factors or product characteristics which are evaluated by organoleptic or physical means, such as colour, flavour, texture, defects, size and appearance. They are not intended however, to cover factors which may represent a hazard to health or which are unwholesome or otherwise highly objectionable to the consumer on the basis of which responsible authorities would reject the lot. Examples of these latter categories are pesticide residues, contaminants, blown cans, foreign material such as stones and large insects. Other criteria and sampling plans must be used in dealing with factors of this type. While these Sampling Plans are intended primarily for **quality evaluation**, they may be found suitable for other determinations such as net weight, Brix values and drained weight, provided an acceptance criterion with an AQL of 6.5 is appropriate for these determinations. In this case a definition of “defective” for the specific determination under consideration would be required in the respective Codex Standard.

#### 2.2 SIZE OF LOT AND POINT OF APPLICATION

The Sampling Plans and acceptance procedures contained in this document are designed to cover **lots** that represent substantial portions of factory production or relatively large blocks of merchandise. The plans may also be used for small lots, but Governments may elect to use sampling procedures of their own choosing for enforcement at the retail level. This is done in recognition of the high ratio of **sample size** to **lot size** when dealing with small lots and the probability that once the production of **defective** or non-conforming product is no longer likely to be uniform between and within the smaller lots.

#### 2.3 PRINCIPLES OF ACCEPTANCE SAMPLING

For detailed explanation of the statistical basis for these Sampling Plans, see Appendix II of this document.

### 3. DESCRIPTION

The Sampling Plans - Appendix I of this document - are a tabular presentation appropriate for acceptance sampling of prepackaged foods where an AQL of 6.5 has been accepted for certain products characteristics. The Plans include:

1. **Inspection Levels;**
2. **Sample Sizes** in relation to lot size and container size; and
3. **Acceptance Numbers.**

A **sample** is drawn at random from the **lot** according to the appropriate schedule in the Sampling Plans. Each **sample unit** is examined according to the requirements of the individual Codex Standard and classified as either “acceptable” or as “defective”. Based on the total number of “defectives” in the sample, the lot either “meets” or “fails” the requirements of the Codex standard, to which these Sampling Plans apply, according to the following criteria:

- **Meets** if the number of “defectives” is equal to, or less than, the acceptance number of the appropriate plan.
- **Fails** if the number of “defectives” exceeds the acceptance number of the appropriate plan.

## 4. DEFINITIONS

### 4.1 ACCEPTABLE QUALITY LEVEL (AQL)

The maximum percent **defective** units (defectives) permitted in a **lot** which will be accepted approximately 95 percent of the time. For example, a sampling plan at an AQL of 6.5 will accept a lot or production which has 6.5 percent defective approximately 95 percent of the time.

### 4.2 ACCEPTANCE NUMBER (C)

The number in a sampling plan which indicates the maximum number of **defectives** permitted in the **sample** in order to consider the **lot** as meeting the requirements of a Codex Standard.

### 4.3 BUYER’S RISK

The risk a buyer takes that a **lot** will be accepted on the basis of these Sampling Plans even though such a lot may fail to conform to the requirements of the Codex Standard.

### 4.4 PRODUCER’S RISK

The risk a producer takes that a **lot** will fail on the basis of these Sampling Plans even though such a lot in reality may meet the requirements of the Codex Standard.

### 4.5 DEFECTIVE

A “defective” is a **sample unit** which does not conform with a certain specified requirement (or requirements) of a Codex Standard (on the basis of total “demerit points”, individual tolerances for “defects”, etc.). The criteria on the basis of which a sample unit is classified as “defective” are specified in individual Codex standards to which these Sampling Plans apply (see also Sub-sections 2.1 and 2.2 of this document). Although a **defective** is a **sample unit** which fails to meet certain specified requirements in Codex standards, it does so only to an extent which is **slightly** below those requirements and which would not make the product objectionable to the consumer as specified in Section 2 - Field of Application, Sub-section 2.1.

### 4.6 INSPECTION

The process of measuring, examining, testing or otherwise comparing a container or unit of product (**sample unit**) with the requirements of a Codex Standard.

### 4.7 INSPECTION LEVEL

The term used to indicate the relative amount of sampling performed on **lots** of a given product or class of products.

#### 4.8 LOT OR INSPECTION LOT

Collection of primary containers, or **sample units**, of the same size, type and style which have been manufactured or processed under essentially the same conditions.

#### 4.9 LOT SIZE (N)

The number of primary containers, or sample units, in the **lot**.

#### 4.10 SAMPLE UNIT

The individual container (primary container), a portion of the contents of the primary container or a composite mixture of product that is examined or tested as a single unit

#### 4.11 SAMPLE

Any number of **sample units** which are used for **inspection**. Generally the **sample** comprises all of the containers or **sample units** drawn for examination or testing purposes from a particular **lot**.

#### 4.12 SAMPLING

The process of drawing or selecting containers or **sample units** from a lot or production.

#### 4.13 SAMPLE SIZE (N)

The number of containers, or **sample units** comprising the total **sample** drawn from a **lot** or production.

#### 4.14 SAMPLING PLAN

A sampling scheme which includes **sample sizes**, **inspection levels**, acceptance and/or rejection numbers so that a decision can be made to accept or reject the **lot** or production based on the results of **inspection** and testing of the **sample**.

### 5. APPLICATION OF THE SAMPLING PLANS

#### 5.1 INFORMATION REQUIRED

In using the Sampling Plans in Appendix I of this document, the following information shall be known:

- a Container size (net weight in kg or lb)
- b Inspection Level (see sub-section 4.7)
- c Lot size (N) (see sub-section 4.9)
- d Requirements of the Codex Standard with respect to product quality (i.e. classification of **defectives** and requirements for acceptance of the **lot**).

#### 5.2 INSPECTION

The following steps are taken:

- a The appropriate **inspection level** is selected as follows:  
Inspection Level I - Normal sampling  
Inspection Level II - Disputes (Codex referee purposes sample size), enforcement or need for better lot estimate.
- b Determine the **lot size** (N), i.e. number of primary containers or **sample units**.
- c Determine the number of **sample units** (**sample size** (n)) to be drawn from the **inspection lot**, consideration being giving to **container size**, **lot size**, and **inspection level**.

- d Draw at random the required number of **sample units** from the **lot** giving proper consideration to code or other identifying marks in selection of the **sample**.
- e Examine the product in accordance with the requirements of the Codex Standard. Classify any container or **sample unit** which fails to meet the specified quality level of the standard as a **defective** on the basis of the classification of defectives contained in the Codex Standard.
- f Refer to the appropriate Sampling Plan in Appendix I.
- g Consider the lot acceptable if the number of **defectives** is equal to or is less than the **acceptance number** (c) of the appropriate **Sampling Plan** contained in Appendix I of this document.
- h Consider the **lot** as failing if the number of **defectives** exceeds the acceptance number (c) of the appropriate **Sampling Plan** contained in Appendix I of this document.

### 5.3 EXAMPLES FOR THE APPLICATION OF THE SAMPLING PLANS

#### a Inspection Level I (see sub-section 5.2 (a))

A **lot** consists of 1200 cases, packed 12 x 2.5 lb primary containers per case. A decision is made to use Inspection Level I since the goods are not in dispute and there is no history of controversy over quality. A container is defined in the Codex Standards or is taken to be the **sample unit**.

Lot Size (N)	=	1200 x 12 or 14,400 units
Container Size	=	2.5 lb
Inspection Level	=	I (see Sampling Plan 1, Appendix I)
Sample size (n)	=	13
Acceptance Number (c)	=	2

In this example if there are no more than two (2) “defectives” in a **sample size** of 13 containers the **lot** is considered acceptable. If, however, there are three (3) or more “defectives” in the **sample** the **lot** is considered as failing to meet the requirements. A “defective” as used in the Sampling Plans is defined in the Codex Standard.

#### b Inspection Level II (see sub-section 5.2 (a))

If in the foregoing example (5.3 (a)) the quality of the goods is in dispute and a referee method is required for the examination or re-examination of the **lot**, an increased **sample size** is taken at Inspection Level II, selecting at least 21 containers.

Lot Size (N)	=	1200 x 12 or 14,400 units
Inspection level	=	II (see Sampling Plan 2, Appendix I)
Sample Size (n)	=	21
Acceptance Number (c)	=	3

### 5.4 NOTES ON SAMPLE SIZE

It is not necessary to restrict the **sample size** to the minimum corresponding to the appropriate **lot size** and **Inspection Level**. In all cases a **larger** sample may be drawn. In the example at 5.3 (b) an even more reliable estimate of **lot** quality could be made by taking a **sample** of 29 or even 48 and applying the corresponding **acceptance numbers** of 4 and 6 respectively.

## APPENDIX I

**SAMPLING PLAN 1****(Inspection Level I, AQL = 6.5)****NET WEIGHT IS EQUAL TO OR LESS THAN 1 KG ( 2.2LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
4,800 or less	6	1
4,801 - 24,000	13	2
24,001 - 48,000	21	3
48,001 - 84,000	29	4
84,001 - 144,000	38	5
144,001 - 240,000	48	6
more than 240,000	60	7

**NET WEIGHT IS GREATER THAN 1 KG (2.2LB) BUT NOT MORE THAN 4.5 KG (10LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
2,400 or less	6	1
2,401 - 15,000	13	2
15,001 - 24,000	21	3
24,001 - 42,000	29	4
42,001 - 72,000	38	5
72,001 - 120,000	48	6
more than 120,000	60	7

**NET WEIGHT GREATER THAN 4.5 KG (10 LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
600 or less	6	1
601 - 2,000	13	2
2,001 - 7,200	21	3
7,201 - 15,000	29	4
15,001 - 24,000	38	5
24,001 - 42,000	48	6
more than 42,000	60	7

**SAMPLING PLAN 2****(Inspection Level II, AQL = 6.5)****NET WEIGHT IS EQUAL TO OR LESS THAN 1 KG (2.2 LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
4,800 or less	13	2
4,801 - 24,000	21	3
24,001 - 48,000	29	4
48,001 - 84,000	38	5
84,001 - 144,000	48	6
144,001 - 240,000	60	7
more than 240,000	72	8

**NET WEIGHT IS GREATER THAN 1 KG (2.2 LB) BUT NOT MORE THAN 4.5 KG (10 LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
2,400 or less	13	2
2,401 - 15,000	21	3
15,001 - 24,000	29	4
24,001 - 42,000	38	5
42,001 - 72,000	48	6
72,001 - 120,000	60	7
more than 120,000	72	8

**NET WEIGHT GREATER THAN 4.5 KG (10 LB)**

Lot Size (N)	Sample Size (n)	Acceptance Number (c)
600 or less	13	2
601 - 2,000	21	3
2,001 - 7,200	29	4
7,201 - 15,000	38	5
15,001 - 24,000	48	6
24,001 - 42,000	60	7
more than 42,000	72	8

## APPENDIX II

**EXPLANATORY NOTES ON ACCEPTANCE SAMPLING****SAMPLING**

Sampling is the process of drawing or selecting containers or sample units from a lot or production. As a result of sampling, information is obtained by which an estimate can be made to accept, reject or negotiate the merchandise in question. Sampling procedures which contain both sample size and acceptance criteria are commonly referred to as “acceptance sampling”.

There are many types of acceptance sampling systems in use today. A plan that is suitable for one product or type of inspection may be entirely unsuitable for another product or inspection system. The plan selected is determined to a large extent by the degree to which it satisfies the needs of the user.

In developing these acceptance sampling plans, initial consideration has been given to quality evaluation of the end product. This requires opening of containers with resultant loss of products. This type of inspection is referred to as “destructive sampling”. Not only is the loss of product an important consideration, but also destructive sampling is generally quite time consuming. Consequently, both inspection time and economic loss of product through destructive inspection are significant limiting factors in developing sampling plans for quality evaluation of processed foods. Sample size must necessarily be relatively small in order to make the plan practical in application.

**RISKS**

The aim of any sampling plan should be to accept more “good” lots and reject more “bad” lots. Since probability and chance are involved, decisions will, of necessity, involve an element of risk. This risk factor has to be accepted as a part of any sampling procedure. One method of reducing the buyer’s risk of accepting deliveries of non-conforming quality is to increase sample size. In other words, the larger the sample, the less risk involved in accepting “bad” lots. Inspection level is the term indicating the relative amount of sampling and inspection performed on lots of a given product or class of products. If the inspection lot is packed under close control and meets the requirements of the Codex Standard, changing inspection levels do not appreciably change the buyer-seller risk. In other words, this would be a “good” lot and should be passed practically all of the time by a good sampling plan. The effectiveness of a sampling plan in discriminating between “good” and “bad” lots can be estimated by examination of the OC curves (see Appendix III) for the various sample sizes. For example, if a lot is produced so that it does not contain more than 6.5 percent defectives, such lot will be passed at least 95 percent of the time by the sampling plans applicable for an AQL of 6.5. On the other hand, if the production contains an appreciable amount of defective material, a higher inspection level (i.e. a larger sample size) will reduce the risk of accepting these non-conforming lots. The effect of increased sample size is explained in greater detail under the discussion of OC curves.

**AQL**

One of the initial considerations in the development of a statistical acceptance sampling plan is the selection of an appropriate AQL or **Acceptable Quality Level**. This characteristic is defined as the maximum percent defective units in lots that will be accepted most of the time (approximately 95 percent of the time). Lots or production containing more defective material will be accepted less often - the ratio of rejection to acceptance increasing as the sample size increases and as the percent defective material in the lot increases.

In developing these sampling plans, an AQL of 6.5 was selected for lot acceptance with respect to **quality evaluation**. In other words, an AQL of 6.5 is used in these sampling plans (Appendix I) to determine

whether or not the inspection lot meets minimum **quality** requirements of the Codex Standard. This value was selected on the basis of years of experience and the capability of industry to produce preserved fruits and vegetables and certain other processed foods at this level under good commercial practice. For other factors (such as Brix value and net weight) other AQLs may be selected. Sampling plans can be drawn up for a full range of AQLs from a very strict value of 0.10 to a rather lenient value of 25.0 and higher, depending either on the type of product and/or on the criteria involved.

### INSPECTION LEVEL

These sampling plans provide for two inspection levels, I and II. These two levels provide some discretion in the application of the Sampling Plans to the inspection of a commodity, depending upon circumstances. For normal trading purposes Level I is recommended. In the case of dispute or controversy, i.e. for Codex referee purposes, Level II is recommended. Smaller sample sizes than those provided by Levels I and II may be justified, e.g. when a delivery is being checked for labelling or for detection of non-permitted additives. However, the acceptance sampling criteria of the Plans, which permit 6.5 percent “defectives”, do not apply to such an inspection.

### OC CURVES

The problem of buyer’s and seller’s risks in relation to sample size and lot quality is illustrated through the use of **Operating Characteristic Curves** (OC Curves). Appendix III contains OC Curves for the sampling plans contained in Appendix I of this document. For Purposes of destructive inspection sample sizes in excess of 84 are not practical, since any further inspection beyond this point will not generally provide sufficient additional data to warrant the time and expense of testing.

In studying the OC Curves for AQL 6.5 several conclusions can be drawn, namely:

- 1 All of the Curves have the same general slope although the curve for sample size 6 is flatter.
- 2 All curves intersect at a point represented by the coordinates of “6.5 percent defective” and approximately “95 percent probability of acceptance”.
- 3 As the sample size increases, the curves become steeper and more discriminating, i.e. lots having “defectives” in excess of 6.5 percent are rejected with greater frequency.
- 4 The reliability of the larger sample size is not in direct proportion to the increased sample. For example, for a lot that is 20 percent defective a sample size of 6 (curve E) will accept such lot 65 percent of the time; whereas a sample size of 48 (curve L) will accept the same lot 22 percent of the time. In this example the ratio between probabilities of acceptance is only 3 to 1.

To illustrate the use of the OC Curves (AQL 6.5) let it be assumed that a lot is 10 percent defective. A lot with 6.5 percent defectives will be accepted approximately 95 percent of the time, the frequency of acceptance increasing as the percent defective decreases. However, the 10 percent defective lot fails to measure up to requirements, and while it may be a marginal lot, it may not be acceptable. An examination of the OC curves shows that a sample size of 6 (curve E) will accept this marginal lot 88 percent of the time; a sample size of 84 (curve M) is somewhat better, accepting the lot 65 percent of the time.

If, on the other hand, the lot is 30 percent defective, a sample size of 6 (curve E) will accept the lot only 42 percent of the time, whereas a sample size of 21 (curve J) will accept such a lot only 8 percent of the time and a sample size of 84 (curve M) will always fail such a lot.



APPENDIX III

OPERATING CHARACTERISTIC CURVES

AQL=6.5

Identification letter of OC curve																				
E			H			J			K			L			M		N			
n	c	r	n	c	r	n	c	r	n	c	r	n	c	r	N	c	r			
6	1	2	13	2	3	21	3	4	29	4	5	48	6	7	84	9	10	126	13	14

OC CURVE - AQL = 6.5

