ABMI
Association of the Beverage Machinery Industry

Method sheet: Filler – Filling volume accuracy
Sheet no.: 050101 – 1.01
Date: June 2008

Machine: **Filler**
Criteria: **Filling volume accuracy (gravimetric method) by weighting the content related to nominal capacity**

Contents:

Filling volume accuracy (gravimetric method) by weighting the content related to nominal capacity

1. Definition: Machine and Criteria

An important parameter of a filling machine is the accuracy of the filling volume. The filling volume can be measured by weighing the contents of the filled package. For all actions the relevant safety instructions must be strictly adhered to.

Further related documents:

- Analytica-EBC
- MEBAK V

2. Inspection

2.1 Scope

Detection of the filling volume in filled packages by means of a scale.

2.2 Apparatus

Scale (as proposed by the European Brewery Convention EBC). The recommended accuracy of measurement instruments is 0.1 g. Visual inspection of measurement device used by a person.

2.3 Procedure

The density (ρ) of the filled product has to be measured accurately. From each bottle, the weight [m] of the contents has to be gauged. Afterwards, the volume [V] must be calculated according to the following equation.

$$V = \frac{m}{\rho}$$

The density of fluid depends on the temperature!

3. Sampling

To check the filling quality, samples of filled packages are needed. Samples to be taken after 15 minutes of production in standard operation at nominal capacity.
Quantity of sample bottles: Quantity of one filler round, maximum 100 bottles.
Before measurement the foam has to turn to liquid and the temperature should be 20°C.

3.1 Calculation

Standard Deviation:
The standard deviation σ is the most commonly used measuring unit in statistics for the statistical spread of results, i.e. for deviations of x_i all individual values around an average $\bar{x}$ expectancy value. The estimate of the standard deviation serves as proof of the warranted value and is calculated from a random sample with an amount of n and shows the statistical spread around the average $\bar{x}$ of the random sample:

Average of the results from measuring the fill level:

$$\bar{x} \quad \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$$

Standard deviation:

$$\sigma - \sqrt{\frac{1}{n-1} \cdot \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

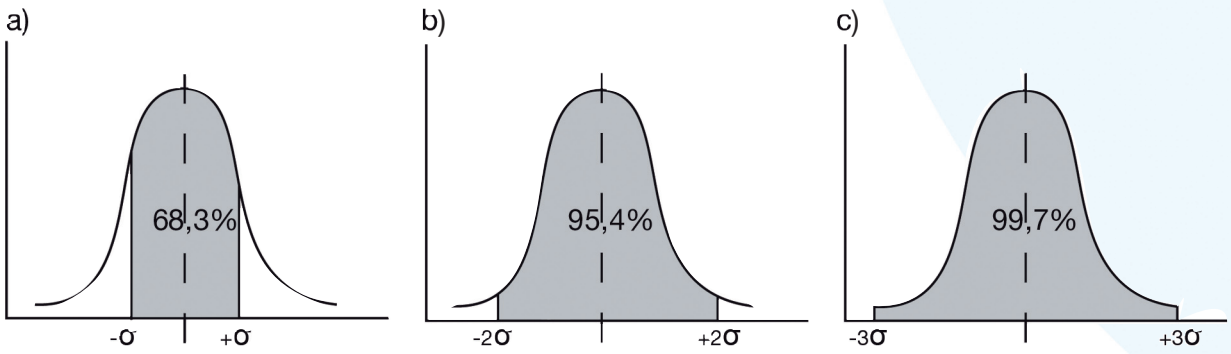
Where the random sample ranges from i = 1 to n (here: n = 100).

Example of a filling volume warranty:

Fill level warranty σ = 1.5 mm means:

a) 68.3% of the values in the batch are approx. $\bar{x} \pm 1\ \sigma = \bar{x} \pm 1.5$ mm
b) 95.4% of the values in the batch are approx. $\bar{x} \pm 2\ \sigma = \bar{x} \pm 3.0$ mm (95.4 - 68.3 = 27.1%)
c) 99.7% of the values in the batch are approx. $\bar{x} \pm 3\ \sigma = \bar{x} \pm 4.5$ mm (99.7 - 95.4 = 4.3%).

Assuming that the individual figures are distributed normally, which might not necessarily be the case.



3.2 Results and data sheets

3.2.1 Data sheet

Date: _____ Site: _____ Line: _____

Fill in the results from measuring the filling volume in gram [g] read from the scale.

Number n:	x_i [g]	Number n:	x_i [g]	Number n:	x_i [g]	Number n:	x_i [g]
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

4. Evaluation and Documentation

4.1 Evaluation

Average of the results $\bar{x}$: _____ g
Standard deviation $\sigma_{current}$: _____ g

Product parameters: _____
Product: _____
Filling temperature _____ °C
Density [ρ]: _____ g/l

Calculated volume for standard deviation:

$$\sigma_{current\ [ml]} = \frac{\sigma_{current\ [g]}}{density\ [\rho]} = \_\_\_\_\_\ ml$$

$$\_\_\_\_\_\ ml = \sigma_{current\ [ml]} \leq \sigma_{set} = \_\_\_\_\_\ ml$$

4.2 Documentation

The fill level accuracy is correct when the standard deviation fulfils the criteria of the following inequality:

$\sigma_{current} \leq \sigma_{set}$ Filling accuracy is o.k. ☐
$\sigma_{current} \geq \sigma_{set}$ Filling accuracy is not o.k. ☐

Name and signature of inspector: _____