Fill/Headspace by Weight

Scope and Application

Wine Fill Tolerances (27 CFR 24.255):

Container Size	Fill Tolerance
≥ 15.0 L	± 1.0%
1.0 to 14.9 L	± 1.5%
750 mL	± 2.0%
375 mL	± 3.0%
187 mL	± 4.5%
50 mL	± 9.0%

Distilled Spirits Fill Tolerances (27 CFR 19.356):

Container Size	Fill Tolerance
≥ 1.0 L	± 1.5%
376 to 999 mL	± 2.0%
101 to 375 mL	± 3.0%
≤ 100 mL	± 4.5%

In addition, a liquor bottle with a capacity of 200 mL or more is considered misleading if it has a headspace in excess of 8% of the total capacity (27 CFR 5.46).

Malt Beverage Fill Tolerances (27 CFR 25.142):
Filling shall be conducted in accordance with "good commercial practice". Historically, the TTB laboratories have considered good commercial practice as ± 2% of label fill for malt beverages.

Levels and Limitations

This method is preferable for opaque containers and cans. It is also suitable for translucent containers.

Supplemental Documents

SSD:WG:112 Sub-sampling

SSD:WG:304a Use of Working Weights and Balances

SSD:TM:102 ***Ethanol Determination by Specific Gravity***

SSD:TM:516 Fill / Headspace by Volume

Equipment

Top loading balance with 0.1 g accuracy (or better)

Density Meter with 0.0001 g/cm^3 accuracy (or better), set at 20 °C

Waterproof Marker

Reagent and Sample Preparation and Handling

No sample prep is necessary. Homogenization is accomplished using **SSD:WG:112**.

Procedures

Note: All procedures for fill in carbonated samples begin with an unopened bottle or can, and in most cases for non-carbonated samples. Sometimes the sample closure is subject to damage by the process of opening the container. This is particularly evident with wine corks where the closure may break apart. In those instances, the analyst may determine that it is better to open the non-carbonated sample prior to weighing to avoid errors due to closure removal or destruction. The sample is immediately stoppered to prevent loss or damage to the contents.

1. For samples in a translucent container, mark the container with a waterproof marker at the Fill Level, and the bottom edge of the closure.
2. Weigh full bottle, with closure, (W_f) after stripping all extraneous attachments from the bottle on the top loading balance.
3. Distilled Spirits and Wine:

   Determine the ***apparent specific gravity (D_s)*** of the liquid contents at 20 °C using the densitometer.

   For Malt Beverages:

   Determine the ***apparent*** specific gravity ***(D_s)*** of the decarbonated beverage at 20°C.
4. After analysis of sample is completed, *drain the bottle or can* by inverting for at least 1 minute after the stream of liquid breaks and drops form.
5. Rinse empty bottle with water and dry, inverted at room temperature, for at least 1 hour.
6. Weigh the empty can or bottle with closure (W_e).
7. For headspace, fill bottle to the brim with water (or to the mark made at the bottom edge of the closure), replace closure and re-weigh (W_{bc}).
8. Note the label volume (V_o).

Note: For translucent containers, violative results are confirmed using fill by volume test method (**SSD:TM:516**) or by filling the container with room temperature water to the mark made in Step 1, reweighing, and using 1.0000 for the sample density. This value is then used to confirm the one determined.

Quality Control

1. ***Prior to weighing: Confirm top loader operating condition by recording two standard weights, for example a 100 g weight and a 1000 g weight. Weight tolerances should be as defined by laboratory protocol, SSD:WG:304a.***
2. Top loading balances should be recalibrated annually and the calibration results should be filed with the balance log book. All weight measurements should be recorded in the log book.
3. Quality control of DMA should be performed according to SSD:TM:102

Sources of Uncertainty

1. The main source of uncertainty may originate from improper use of a top loading balance. Therefore, particular care should be taken in assuring the proper and timely maintenance and calibration of the balances.
2. Accuracy and precision of the density meter may also be a factor of uncertainty. The density meter should be calibrated and ***results of laboratory control sample run in duplicate should be within established tolerance range.***

Calculations

Distilled Spirits and Wines:

Fill

Absolute Fill at 60°F $(V_1) = (W_f - W_e)/(D_s \times 1.0008)$
Fill as % of label contents = $(V_1) \times 100/V_o$

Headspace

Volume of the bottle $(V_b) = (W_{bc} - W_e)/(0.9982 \times 1.0008)$
Headspace % = $[(V_b - V_1)/V_b] \times 100$

Malt Beverages:

Fill

Absolute Fill at 4 ºC $(V_1) = (W_f - W_e)/(\boldsymbol{D_s} \times 1.00177)$
Fill as % of label contents = $(V_1) \times 100/V_o$

Note: ***(1) 1.0008 and 1.00177 are factors to convert volume from 20ºC to required fill reporting temperature in mL.***
(2) 0.9982 is the density of water at 20°C.

Reporting Results

Fill is reported as % of label contents with one decimal, i.e. xxx.X% and as mL with no decimal place, i.e. XXX mL. Headspace is reported as % with one decimal place, i.e. xxx.X%.

Compliance is called on wine and distilled spirits based on the fill tolerances given in the 27 CFR. Compliance is not called on malt beverages, rather any container filled beyond ± 2% of the labelled volume is noted in the "Summary of Findings" narrative section of the results report.

Safety Notes

Normal laboratory safety protocol should be followed.

References

27 CFR §24.255; §19.356; §5.46 and §***25.142***

Location of Validation Package.

Quality System Files

Required Training, Certification and Re-certification.

1. In-house training by a certified chemist.
2. Demonstrate competency by taking written test and by performing the technique.
3. Recertification every 5 years.

Revision History

Rev. 3 -- Allows for verifying noncompliant results using water; Changes calculation for malt beverages to use SG rather than density (8/21/2009)

Rev. 4 – Edits for consistency and clarity. Addition of compliance statement.