

Courtesy Copy	SSD:TM:512	Rev. 4
	Issue Date: 11/29/2017	Page 1 of 4
	Implementation Date: 12/13/2017	

The colored ink stamp indicates this is a controlled document. Absence of color indicates this copy is not controlled and will not receive revision updates.

Solids/Extract: Specific Gravity Method

Scope and Application

This method applies to the determination of dissolved solids in all alcoholic beverages. The terms, solids and extract, are used interchangeably to mean concentration of dissolved solids.

Distilled spirits products labeled "liqueur" or "cordial" must contain at least 2.5% sugar by weight (27CFR 5.22 (h)).

Wine solids, especially in ameliorated products, are subject to limitations prescribed in 27CFR 24.179.

Levels and Limitations

Analyte / Matrix	Detection Limit	Quantitation Limit	Linear Range	Interferences
Extract / Wine	N/A	N/A	Not Applicable	Glycerol, Propylene Glycol, and other high-boiling liquids
Solids / Distilled Spirits	N/A	N/A	Not Applicable	Glycerol, Propylene Glycol, and other high-boiling liquids
Real Extract / Malt Beverages	N/A	N/A	Not Applicable	Glycerol, Propylene Glycol, and other high-boiling liquids

Equipment

Density Meter (Anton Paar or equivalent) reporting **specific gravity** to 5 decimal places, temperature controlled + 0.01°C.

Automatic Sample Changer (Anton Paar SP-3 or equivalent) or sample transport system or direct injection syringe.

Class A Volumetric Flask

Reagent and Sample Preparation and Handling

Samples must be at room temperature.

Carbonated samples must be de-carbonated before pipetting.

The colored ink stamp indicates this is a controlled document. Absence of color indicates this copy is not controlled and will not receive revision updates.

General Procedure

Wine, Distilled Spirit and Malt Beverages:

1. Determine the specific gravity at 20°C of the sample and record as $SG_s^{20/20}$.
2. Determine the specific gravity at 20°C of the alcohol-water distillate from **SSD:TM:102** and record as $SG_a^{20/20}$. If the only datum available is the % v/v alcohol, obtain $SG_{app}^{20/20}$ from AOAC Table 913.02 and convert to $SG_a^{20/20} = 0.9988SG_{app}^{20/20} + 0.0012$.

Malt Beverages-Alternative Procedure:

1. For direct measurement of dealcoholized sample:

- a. Transfer the distillation residue from SSD:TM:102 to a volumetric flask and Q.S. with distilled water. The volume of the volumetric flask should be the same as the original volume of the sample before distillation.

Alternatively, in an evaporation dish place enough sample that the total weight of the dish with sample is 200.00 ± 0.02 g. Evaporate the sample gently (steam **bath** or overnight in the hood) so that only about a third of the original volume of sample remains. Cool to room temperature and using DI water, bring the total weight of the sample back to 200.00 ± 0.02 g.

- b. Determine Specific Gravity of the dealcoholized sample **and** Record as $SG_d^{20/20}$.

Quality Control

1. Laboratory control samples (LCS) are to be measured in duplicate in accordance with **laboratory protocol**.

Sources of Uncertainty

1. Ensure DMA is calibrated and functioning properly
2. **If using distillation residue, ensure that antifoam was not used during distillation process.**

Calculations

1. Any apparent specific gravity values should be converted to in vacuo basis because the Brix and Plato tables are in these terms. The conversion is

$$SG^{20/20} = 0.9988SG_{app}^{20/20} + 0.0012$$

2. Calculate the specific gravity at 20°C of the dealcoholized sample as

$$SG_d^{20/20} = SG_s^{20/20} - SG_a^{20/20} + 1 = 0.9988(SG_{s_{app}}^{20/20} - SG_{a_{app}}^{20/20} + 1) + 0.0012.$$

The colored ink stamp indicates this is a controlled document. Absence of color indicates this copy is not controlled and will not receive revision updates.

3. Obtain % w/w solids in dealcoholized sample from AOAC Table 942.33 or 970.90 or from Ruppert's formula, $187f^3 - 229.8f^2 + 259.17f - 0.0061$, where f is the fractional part of $SG_d^{20/20}$ or $SG_d^{20/20} - 1$, and record as P_d .

$$\%w/w = P_d \frac{SG_d^{20/20}}{SG_s^{20/20}}$$

4. Solids as

5. Solids as $g/100mL = 0.9982073P_dSG_d^{20/20}$. Note: The density of water at 20°C

(ρ_w^{20}), 0.9982073 g/mL, is needed to convert $SG_d^{20/20}$ to ρ_d^{20} . This value for ρ_w^{20} is different from that of Chappuis (0.9982343 g/mL— still used in the tables of the AOAC and the ASBC) because the current standard mL is smaller by a factor of 1.000027. Also, it is not necessary to convert to sample units from dealcoholized sample units in the above equation because 100mL of one is identical to 100mL of the other.

6. Solids as $g/100L = 998.2073P_dSG_d^{20/20}$.

Reporting Results

Report the results for **solids** as follows:

Sample Type	Units	Precision	Format
Distilled Spirits	g/100L	1 decimal	x.X
High Solids Distilled Spirits	% w/w	1 decimal	x.X
Wine	g/100mL	2 decimal	x.XX
Malt Beverages	% w/w	1 decimal	x.X

Note on the report the misclassification of a product labeled as **(1)** cordial or liqueur containing less than 2.5% w/w dissolved solids or **(2)** straight or blended whiskey containing more than 2.5% w/w dissolved solids.

Safety Notes

Normal laboratory safety protocol should be followed. High proof alcoholic products are flammable. Ethanol burns with an almost invisible blue flame.

References

Chappuis, P. Bureau International des Poids et Mesures. Travaux et Mémoires XIII, D, 1-40 (1907) as referenced in Standard Density and Volumetric Tables (1924) NBS Circular 19, 6th Ed., Government Printing Office, Washington, DC.

Courtesy Copy	SSD:TM:512	Rev. 4
	Issue Date: 11/29/2017	Page 4 of 4
	Implementation Date: 12/13/2017	

The colored ink stamp indicates this is a controlled document. Absence of color indicates this copy is not controlled and will not receive revision updates.

Methods of Analysis 8th revised Ed., 1992-1999, ASBC, St. Paul, MN, method Beer-5B.

Official Methods of Analysis (1999) 16th Ed., 5th Revision, 1999, AOAC International, Gaithersburg, MD, methods 920.62, 940.09, 945.09 and 960.62.

Ruppert, J.R., JAOAC, 69 4 1986 pp709-711

SSD:TM:102

Location of Validation Package

No validation necessary. This method is a calculation.

Required Training, Certification and Re-certification

1. In-house training by a certified chemist.
2. **At least 7 replicates of an LCS within established control limits.**
3. Chemists will be competency tested periodically (e.g., every 5 years).

Revision History

Rev. 2 – General editorial changes and clarification as a result of the document review – 11/12/2008

Rev. 3 – edits to step 4 to more clearly describe the evaporation process, edit reporting digits for wine samples to two decimal places – 3/21/12

Rev. 4 – Consolidated the Procedure section. Added use of Antifoam to the Uncertainty section. Updated Reference section.