



Designation: D 2109 – 01

Standard Test Methods for Nonvolatile Matter in Halogenated Organic Solvents and Their Admixtures¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods cover the determination of nonvolatile matter in halogenated organic solvents and admixtures.

1.2 Five test methods are covered, as follows:

1.2.1 *Test Method A*—For halogenated organic solvents or admixtures having less than 50 ppm nonvolatile matter; or where precision better than ± 10 ppm is required.

1.2.2 *Test Method B*—For halogenated organic solvents or admixtures having more than 50 ppm nonvolatile matter or where precision of $\pm 0.001\%$ (10 ppm) is satisfactory.

1.2.3 *Test Method C*—For low-boiling halogenated organic solvents or their admixtures (for example, methylene chloride, trichlorotrifluoroethane) that may superheat and cause bumping while evaporating to dryness with steam. A precision of greater than ± 10 ppm can be attained.

1.2.4 *Test Method D*—For rapid measurement of nonvolatile matter in halogenated organic solvents and their admixtures and where precision better than ± 10 ppm is required.

1.2.5 *Test Method E*—For halogenated organic solvents or admixtures and where precision better than ± 10 ppm is required.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 The term *nonvolatile matter* should not be construed as equivalent to *residue on ignition*, *ignition residue*, or *ash content*. Particulates, sediments, and suspended matter should not be considered part of nonvolatile matter. If these solids are present in the sample, they should be removed by filtration or

decantation prior to beginning this test method. Nonvolatile matter is considered to be “in solution” with the solvent and that which will become residual upon drying the solvent at a specified temperature.

2.1.2 Nonvolatile matter and nonvolatile residue are interchangeable terms.

3. Significance and Use

3.1 Nonvolatile matter in solvents can adversely affect their cleaning properties. These test methods can be used to control soil contamination in the boiling solvent, which if allowed to become too high, can decrease the stability of the solvent.

3.2 These test methods can be used to establish manufacturing and purchasing specifications.

4. Apparatus

4.1 *Oven*, thermostatically controlled at $105 \pm 5^\circ\text{C}$.

4.2 *Evaporating Dish*, 125-mL capacity, platinum or high-silica glass, Methods A, B, C.

4.3 *Evaporating Dish* (80×45 or 115×50) (Method D).

4.4 *Steam Bath* (or hot plate).

4.5 *Hot Plate*, (Method D).

4.6 *Heat Lamp*, 250 W, (Method E).

4.7 *Analytical Balance*, capable of measuring to 0.0001 g.

4.8 *Top Loading Balance*, capable of weighing to 0.01 g.

4.9 *Aluminum Weighing Dish*, 57×18 mm, (Method D).

4.10 *Aluminum Weighing Dish*, 200 mL capacity, (Method E).

4.11 *1000-mL Volumetric Flask* (Test Method A).

4.12 *100-mL Volumetric Pipet* (Test Method B and E).

4.13 *1000-mL Graduated Cylinder* (Test Method C).

4.14 *1500-mL Erlenmeyer Flask* (Test Method C).

TEST METHOD A

5. Procedure

5.1 Dry a 125-mL capacity platinum (or high-silica glass) evaporating dish in an oven at $105 \pm 5^\circ\text{C}$ and cool in a desiccator. Repeat until the weight is constant or within 0.1 mg of the last weighing. Rinse a clean dry 1000-mL volumetric flask with the solvent and fill to the 1000-mL mark with the

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solvent to be tested. Invert the evaporating dish, place it over the mouth of the flask, hold it firmly in place, and invert the flask. In this position place both dish and flask on a steam bath. Adjust a ring support to hold the flask so the mouth of the flask is approximately 25 mm above the bottom of the evaporating dish. Thus held, the flask automatically feeds the solvent to the dish during the evaporation. (**Warning**—This test method must be run in a ventilated, dust-free area.)

5.2 Evaporate the 1000-mL sample to dryness. Remove the dish from the steam bath with metal tongs and blot the outside of the dish with lint-free paper tissue.

NOTE 1—Hot plates develop high temperatures on the plate surface. If a hot plate is used to evaporate the solvent, the evaporating dish should be placed inside a water bath while on the hot plate to prevent the sample from reaching temperatures exceeding 105°C.

5.3 Place the dish and contents in an oven at $105 \pm 5^\circ\text{C}$ for approximately 1 h. Cool in a desiccator and weigh the dish and contents.

6. Calculation

6.1 Calculate the nonvolatile matter and report in weight percent or parts per million as follows:

$$\text{Nonvolatile matter, ppm by weight} = \frac{(A)(10^6)}{(B)(1000)} = \frac{(A)(1000)}{(B)} \quad (1)$$

where:

A = grams of residue, and
 B = density of sample.

7. Precision and Bias ²

7.1 *Repeatability (Single Analyst)*—The standard deviation of results has been estimated to be 0.2 weight ppm. Two such values should be considered suspect (95 % confidence level) if they differ by more than 0.7 ppm.

7.2 *Reproducibility (Multilaboratory)*—The standard deviation of results has been estimated to be 1.0 weight ppm. Two such values should be considered suspect (95 % confidence level) if they differ by more than 4.6 weight ppm.

TEST METHOD B

8. Procedure

8.1 Dry a 125-mL capacity platinum (or high-silica glass) evaporating dish in an oven at $105 \pm 5^\circ\text{C}$ and cool in a desiccator. Repeat until the weight is constant or within 0.1 mg of the last weighing. Pipet 100 mL of sample into the dish and place on a steam bath.

8.2 Evaporate the sample to dryness as in Section 5 (see Note 1 and Note 1). Remove the dish from the steam bath with metal tongs and blot the outside of the dish with lint-free paper tissue.

8.3 Place the dish and contents in an oven at $105 \pm 5^\circ\text{C}$ for approximately 1 h. Cool in a desiccator and weigh the dish and contents.

9. Calculation

9.1 Calculate the nonvolatile matter and report in weight percent as follows:

$$\text{Nonvolatile matter, ppm by weight} = \frac{(A)(100)}{(B)(100)} = \frac{(A)}{(B)} \quad (2)$$

where:

A = grams of residue, and
 B = density of sample.

10. Precision and Bias ²

10.1 *Precision*—As the only significant difference between Test Method B and Test Methods A and C is the sample size (100 mL versus 1000 mL), it is reasonable to assume that the precision is roughly ten times that of Test Methods A and C or 2 ppm for repeatability and 10 ppm for reproducibility.

10.2 The bias of this test method has not been determined.

TEST METHOD C

11. Procedure

11.1 Dry a 125-mL capacity platinum (or high-silica glass) evaporating dish in an oven at 105°C and cool in a desiccator. Repeat until the weight is constant or within 0.1 mg of the last weighing. Rinse a clean dry 1000-mL graduated cylinder and a 1500-mL Erlenmeyer flask with the solvent to be tested.

11.2 Measure 1000 mL of the sample into the cleaned graduate and transfer 970 mL of it into the clean Erlenmeyer flask. Evaporate to about 40 mL on a steam bath or warm hot plate in a fume hood. Do not evaporate to dryness.

11.3 Transfer the residue to the evaporating dish. Rinse the flask twice with a 15-mL portion of the sample retained in the graduate (see Note 2). Add the rinsings to the evaporating dish.

NOTE 2—All of the retained sample is used to rinse the beaker and must be included in the sample volume.

11.4 Allow the sample to evaporate by gently heating on a warm hotplate. Protect the evaporating dish from external contamination and do not exceed 60°C (140°F). When evaporation is complete, dry the evaporating dish in the oven at 105°C for 30 min, cool in a desiccator for 30 min, and reweigh.

12. Calculation

12.1 Calculate the nonvolatile matter and report in parts per million as follows:

$$\text{Nonvolatile matter, ppm by weight} = \frac{(A)(10^6)}{(B)(1000)} = \frac{(A)(1000)}{(B)} \quad (3)$$

where:

A = grams of residue, and
 B = density of sample.

13. Precision and Bias ²

13.1 *Repeatability (Single Analyst)*—The standard deviation of results has been estimated to be 0.2 weight ppm. Two such values should be considered suspect (95 % confidence level) if they differ by more than 0.7 ppm.

13.2 *Reproducibility (Multilaboratory)*—The standard deviation of results has been estimated to be 1.0 weight ppm. Two

² A research report is available from ASTM headquarters. Request RR: D26-1017.