



Standard Test Method for Storage Stability of Water-in-Oil Emulsions by the Oven Test Method¹

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1. Scope

1.1 This test method covers the stability of water-in-oil emulsions when held at a constant elevated temperature.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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. Referenced Documents

2.1 *ASTM Standards:*²

D1744 Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent
E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Summary of Test Method

3.1 A 100-mL sample contained in a graduated 100-mL cylinder is placed in a thermostatically controlled oven at 85°C (185°F) for 48 or 96 h. The sample is then examined for the amount of free oil and free water separated. In addition, water contents of the sample at specified levels in the upper and lower layers of the sample are also obtained.

4. Significance and Use

4.1 This test method indicates the stability of the emulsion during storage and normal usage.

5. Apparatus

5.1 *Convection Oven*, meeting the requirements of Specification E145.

5.2 *Graduated Cylinder*—A stoppered 100-mL glass cylinder graduated in 1-mL increments.³ The stopper should have a vent groove to prevent pressure buildup during the test.

5.3 *Pipet*, 10-mL glass.

5.4 *Microsyringe*, 0.05-mL glass with a fixed needle, No. 19 gage, point style No. 3.

5.5 *Glass Vials*, approximately 30-mL size.

6. Preparation of Sample

6.1 To ensure uniformity of the sample, it should be mixed thoroughly before removing the quantity required for the test. Vigorous hand shaking or mechanical mixing for 3 to 5 min is recommended for litre-size containers or less.

6.2 Special difficulties arise in mixing and withdrawing representative samples from large containers. This is due to the nature of water-in-oil emulsions which are two-phase systems as distinct from truly homogeneous systems. Vigorous mechanical stirring for an extended period is the best means of achieving homogeneity. However, for unstable emulsions that have been in storage for some time, there is no satisfactory way to obtain a representative sample.

7. Test Method A—48-h Test

7.1 After careful preparation of the sample to obtain homogeneity (described in Section 6), transfer 100 mL to a graduated 100-mL cylinder. Insert the vented stopper.

7.2 Place the cylinder in a convection oven maintained at $85 \pm 1^\circ\text{C}$ ($185 \pm 2^\circ\text{F}$) for a period of 48 h. Take care to position the graduated cylinder in the oven generally in the center and raise at least 75 mm from the bottom of the oven, to ensure temperature uniformity.

NOTE 1—When carrying out a number of tests at the same time, arrange the cylinders to avoid developing temperature variations in the oven due to inadequate convection. The number of tests carried out at the same time should, for the same reason, also be restricted.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.N0.02 on Industrial Applications.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ A “crows-foot” cylinder, British Standard BS 658, may be used.

7.3 Withdraw the cylinder from the oven and allow to stand at room temperature, $21 \pm 3^\circ\text{C}$ ($70 \pm 5^\circ\text{F}$), for a period of 1 h.

7.4 Observe and record:

7.4.1 The amount of oil separated, percent volume and

7.4.2 The amount of water separated, percent volume.

7.5 By means of a 10-mL pipet, withdraw aliquots in the following order:

7.5.1 With the pipet tip located exactly at the 80-mL mark, slowly withdraw a 10-mL sample and transfer to a small glass vial. This is designated as the upper layer sample.

7.5.2 With the pipet tip located exactly at the 15-mL mark, slowly withdraw a 10-mL sample and transfer to a small glass vial. This is designated as the lower layer sample.

NOTE 2—In the event that the amount of separated water equals or exceeds 10 % by volume then the determination of the water content of the lower layer is an optional procedure.

7.6 Determine the water content, as percent weight, of the upper layer and lower layer samples, after shaking, by the procedure given in the Annex. Use a 0.05-mL sample transferred by means of a glass microsyringe.

8. Test Method B—96-h Test

8.1 This procedure is identical to that described under Section 7 except that the time period in the convection oven (7.2) is changed from 48 h to 96 h.

9. Report

9.1 Since the test can be performed on the basis of 48 h in the oven (Test Method A) or 96 h (Test Method B), the report is to indicate the procedure followed.

9.2 Report the results as follows:

9.2.1 Oil separation, percent volume,

9.2.2 Water separation, percent volume,

9.2.3 Upper layer water content, percent weight, and

9.2.4 Lower layer water content, percent weight.

10. Precision and Bias⁴

10.1 The precision (Note 3) of this test method is dependent on the degree of stability of the emulsion, as follows:

⁴ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1158.

TABLE 1 Repeatability and Reproducibility

	Free Oil, %	Free Water, %	Difference in % Water Content Upper Layer Versus Lower Layer
Repeatability	1	1	10
Reproducibility	3	1	14

10.1.1 Type I—Stable Emulsions (Procedures A and B):

10.1.1.1 The precision of the test method as determined by the statistical examination of interlaboratory test results is as follows.

10.1.1.2 *Repeatability*—The difference between successive results obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty. (See Table 1.)

10.1.1.3 *Reproducibility*—The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would, in the long run, exceed the following values only in one case in twenty. (See Table 1.)

NOTE 3—Precision limits are based on a round-robin test program carried out in Technical Division N in 1977 using invert emulsion samples with water contents between 35 and 50 % (weight). Eleven cooperators tested five samples representing highly stable, borderline, and unstable emulsions.

10.1.2 Type II—Highly Unstable Emulsions—The precision limits for the 96-h test are of the same order as for Type I. The 48-h test would be less severe and less precise.

10.1.3 Type III—Emulsions of Borderline Stability—No precision limits can be set since the change in the sample stability with time or conditions, or both, of handling make it impractical to determine meaningful precision limits.

10.2 *Bias*—No bias statement is possible because there is no absolute value. The results are interpretable only with respect to this test.

11. Keywords

11.1 emulsions; oil separation ; water separation