Designation: F 1317 – 98 (Reapproved 2002)

Standard Test Method for Calibration of Microwave Ovens[1]

This standard is issued under the fixed designation F 1317; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method is applicable to microwave ovens designed for both home and commercial use. It was developed for use in the evaluation of volatile and nonvolatile components of microwave susceptor packages.

1.2 This test method was collaboratively evaluated with microwave ovens with nominal output ratings of 700 W.

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:*

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[2]

F 874 Test Method for Temperature Measurement and Profiling for Microwave Susceptors[3]

F 1308 Test Method for Quantitating Volatile Extractables in Microwave Susceptors Used for Food Products[3]

F 1349 Test Method for Nonvolatile Ultraviolet (UV) Absorbing Extractables from Microwave Susceptors[3]

F 1500 Test Method for Quantitating Non-UV-Absorbing Nonvolatile Extractables from Microwave Susceptors Utilizing Solvents as Food Simulants[3]

F 1519 Test Method for Qualitative Analysis of Volatile Extractables in Microwave Susceptors Used to Heat Food Products[3]

3. Apparatus and Reagents

3.1 *Microwave Oven*, as manufactured.

3.2 *Beakers*, 2 L. (Alternatively use a 2-L polystyrene foam container.)

3.3 *Thermometer*, readable to ±0.5°C.

3.4 *Stopwatch*.

4. Procedure

4.1 Using the stopwatch, check the accuracy of the microwave oven timer. Timer should be accurate to within 2 %. If not, determine the settings necessary to ensure accuracy.

4.2 Fill a 2 L beaker with exactly 1000 mL of distilled water at 18 to 20°C. Record initial temperature of the water as T_1.

4.3 Remove the thermometer and place the beaker in the center of the microwave oven. If the oven has been used recently, allow it to cool until it is at room temperature.

4.4 Microwave at full power for 2 min 3 s. The additional 3 s is to allow for the magnetron start up delay.

4.5 Immediately after the power cycle completion, immerse the thermometer in the water and vigorously stir. Measure the temperature of the water. Record this temperature as T_2.

4.6 Repeat the measurements to obtain triplicate measurements of the temperature rise.

4.7 Once calibrated, this oven can be used for analytical test standards such as Test Methods F 874, F 1308, F 1349, F 1500, and F 1519.

4.8 Recalibrate oven daily.

5. Calculation

5.1 Calculate the output, *O*, of the microwave oven in watts using the following formula:

$$O = 34.9\,(T_2 - T_1)$$

where:

T_1 = initial temperature of the water,° C, and

T_2 = final temperature of the water, °C.

5.2 Average the three output values and use this mean as the calibrated output wattage of the microwave oven.

6. Report

6.1 Report the following information:

6.1.1 Mean and standard deviation of these values for output wattage of the microwave oven.

7. Precision and Bias

7.1 Seven laboratories participated in the collaborative study, each using a microwave oven with a rated output of 700 W. From the data submitted, the mean output calculated was 686 W, with a within-lab coefficient of variation of 2.1 %, a between-lab coefficient of variation of 5.9 % and an overall

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[2] *Annual Book of ASTM Standards*, Vol 14.02.

[3] *Annual Book of ASTM Standards*, Vol 15.09.

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coefficient of variation of 6.3 %. The data are shown in Table 1 which is based on a round robin test conducted in 1989. Each laboratory provided their own ovens. Each test result was the test value of an individual determination. Each laboratory obtained three test results for their oven. (**Warning**—The following explanations of RS_r and RS_R(7.2-7.2.2) are only intended to present a meaningful way of considering the approximate precision of this test method. The data in Table 1 should not be rigorously applied to acceptance or rejection of microwave ovens, as those data are specific to the round robin and may not be representative of other conditions. Users of this test method should apply the principles outlined in Practice E 691 to generate dataspecific to their laboratory and materials, or between specific laboratories. The principles of 7.2-7.2.2 would then be valid for such data.)

TABLE 1 Raw Data

Laboratory	Rating	Run 1	Run 2	Run 3
Laboratory No. 1	700	700	690	683
Laboratory No. 2	700	750	683	700
Laboratory No. 4	700	564	602	581
Laboratory No. 7	700	700	691	718
Laboratory No. 9	700	687	677	666
Laboratory No. 10	700	665	682	682
Laboratory No. 12	700	665	665	648
Mean, W		671		
Within Lab *COV* (RS_r),%		2.1		
Between Lab *COV* (RS_L), %		5.9		
Overall *COV* (RS_R),%		6.3		

7.2 *Concept of* RS_r *and* RS_R:

7.2.1 If RS_r and RS_R have been calculated from a large enough body of data, and for test results that were test values from testing individual specimens:

7.2.2 Relative repeatability RS_r compares two test results for the same material, obtained by the same operator using the same equipment on the same day.

7.2.3 Relative reproducibility RS_R compares two test results for the same material, obtained by different operators using different equipment in different laboratories.

7.3 There are no recognized standards by which to estimate bias of this test method.

8. Keywords

8.1 microwave ovens, calibration; microwave susceptors; ovens, microwave; calibration; susceptors, microwave

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