



Designation: F 874 – 98

## Standard Test Method for Temperature Measurement and Profiling for Microwave Susceptors<sup>1</sup>

This standard is issued under the fixed designation F 874; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This is a test method for measuring surface temperatures attained by microwave interactive packaging and cooking aids (that is, susceptors). It is useful for measuring susceptor/food interface temperatures during microwave preparation of foods with susceptor-based packaging, heating pads, and crisping sleeves, etc. It may also be used to measure the temperature of a susceptor exposed to extractives testing or in a liquid extraction cell to be used for nonvolatile extractives testing. The latter procedures are performed to establish test conditions for conducting extraction and migration studies using temperature versus time profiles approximating those for actual microwave preparation of the product.

1.1.1 Several of the steps of this test method are taken directly from Test Method F 1308 which gives extraction testing procedures for susceptors.

1.2 *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:

F 1308 Test Method for Quantitating Volatile Extractables in Microwave Susceptors Used for Food Products<sup>2</sup>

F 1317 Test Method for Calibration of Microwave Ovens<sup>2</sup>

F 1349 Test Method for Nonvolatile Ultraviolet (UV) Absorbing Extractables from Microwave Susceptors<sup>2</sup>

F 1500 Test Method for Quantitating Non-UV-Absorbing Nonvolatile Extractables from Microwave Susceptors Utilizing Solvents as Food Simulants<sup>2</sup>

### 3. Apparatus

3.1 *Microwave Oven*, no turntable, unmodified except for small holes to allow for probe lead access to the oven cavity. The oven should be calibrated in accordance with Test Method F 1317.

3.2 *Fluoroptic Thermometry System*.<sup>3</sup>

3.3 *Vials*, headspace, 20 mL.<sup>4</sup>

3.4 *Septa*, polytetrafluoroethylene (PTFE) polymer faced silicone rubber.<sup>5</sup>

3.5 *Vial Crimp Caps*.<sup>6</sup>

3.6 *Microwave Nonvolatile Extraction Cell*<sup>7</sup>—This cell must be constructed of PTFE-fluorocarbon polymer.<sup>8</sup> Additional details on this cell may be found in Test Method F 1349.

3.7 *Beakers*, 600 and 250 mL, or other sizes as appropriate.

3.8 *Aluminum Foil*, household roll.

3.9 *Adhesive Tape*, such as Kapton high-temperature tape, vinyl tape, silicone tape, etc.<sup>9</sup>

3.10 *High-Vacuum Silicone Grease*.<sup>10</sup>

3.11 *Syringe Needle*, 13 gage diameter.

3.12 *Corn Oil*, Miglyol 812 (a fractionated coconut oil), or synthetic fat simulant HB 307. See Test Method F 1349 for details.

3.13 *Petri Dishes*.

3.14 *Fan*, tabletop.

3.15 *Blue Ice*.

<sup>3</sup> Luxtron Model 750 or equivalent, with Luxtron MIH or MIW temperature probes, or equivalent. Available from Luxtron Inc., 106 Terra Bella Ave., Mountain View, CA 90403.

<sup>4</sup> Available from Shamrock Glass Co., 200 N. Delaware Ave., Seaford, DE 19973 (Catalog No. 667601) or Chemical Research Supplies, PO Box 888, Addison, IL 60101 (Catalog No. 237502), or equivalent.

<sup>5</sup> Available from Shamrock Glass Co. (Catalog No. 778173A) or Hewlett Packard (Catalog No. 5080-8726), or equivalent.

<sup>6</sup> Available from Shamrock Glass Co. (Catalog No. 778704) or Hewlett Packard Computer Supplies Operation, PO Box 62124, San Francisco, CA 94162 (Catalog No. 07675-20625), or equivalent.

<sup>7</sup> Available from Waldorf Corp., 2250 Wabash Ave., St. Paul, MN 55114.

<sup>8</sup> PTFE-fluorocarbon polymer materials may be purchased from Read Plastics, Rockville, MD, or equivalent.

<sup>9</sup> Available from Curtin Mattheson Scientific (Catalog No. 301-911).

<sup>10</sup> Available from Curtin Mattheson Scientific (Catalog No. 218-636).

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F-2 on Flexible Barrier Materials and is the direct responsibility of Subcommittee F02.30 on Test Methods.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 15.09.

3.16 Vials, for alternative profile method, 40-mL clear vials.<sup>11</sup>

3.17 Screw Caps.<sup>12</sup>

**4. Procedure**

4.1 *General:*

4.1.1 Start all tests with a cool microwave oven, that is, ambient temperature. Use a fan and blue ice to cool oven floor or any other reliable method to suitably return the oven to ambient temperature between replicates.

4.1.2 Test three replicates per variable.

**5. Measurement of Food/Susceptor Interface Temperature During Microwave Cooking**

5.1 Place product in center of the microwave oven as a consumer would. Mark the position of first replicate on oven floor, and position subsequent replicates similarly.

5.2 Position probes at food susceptor interface in such a manner that good probe/susceptor contact is maintained during cooking, disturbing the food load as little as possible. The analyst may wish to position multiple probes on different regions of the susceptor, such as the center and edge, as the temperature attained at different locations may differ significantly.

5.2.1 If the nature of the product permits, the analyst may wish to determine whether probes positioned parallel to the susceptor surface, or abutted to the susceptor surface would result in better temperature measurement as evidenced by better reproducibility between replicate runs and less discontinuity, due to loss of contact, of temperature readings versus time.

5.3 For in-package measurements for products such as microwave popcorn, probe access into the package is achieved by drilling approximately 0.1-in. holes through the package. (See Fig. 1 for probe placement inside a popcorn bag.) It is also advisable to route the probes along the bottom of the package to avoid disruption of probe/susceptor contact as the bag expands during cooking. If it has been demonstrated that the outer bag surface and inner bag surface temperatures are equivalent, then taping the probes to the outer surface would be satisfactory.

5.4 For products prepared on a susceptor board, such as microwave pizza, the probe should be immobilized to the susceptor board in parallel contact by applying a suitable adhesive tape 0.5 in. behind the probe tip.

5.5 For products without free fat or oil at the food susceptor interface, it is advisable to apply high-vacuum silicone grease to the tip of the probe to assure good thermal contact with the susceptor.

5.6 Microwave at full power for the maximum directed cooking time of the product, recording the temperature of each probe, preferably at 5-s intervals, but at intervals not to exceed 15 s. It is suggested that readings be taken at 1-s intervals if possible, in order to generate a smoother curve. Calculate the average of the replicate runs at each recorded time for each probe position. Do not use data if discontinuities appear in plot (indicative of loss of susceptor/probe contact).

**6. Temperature Profiling of Susceptors in Vials Used for Volatile Extractives Testing**

6.1 First determine the temperature versus time profile for the product during microwave preparation in accordance with Section 5.

6.2 Cut a 10 by 65-mm (6.5 cm<sup>2</sup> or 1-in.<sup>2</sup>) portion from the susceptor sample to be tested. Insert carefully into vial, positioning the sample on the vial side, with the active side facing into the vial.

6.3 Using a 13-gage syringe needle, pierce a hole into a septum, place septum on vial and crimp.

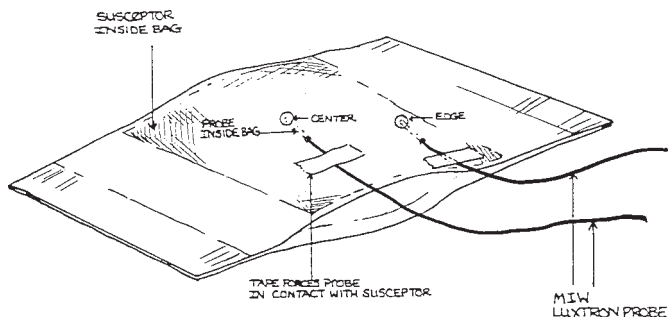
6.4 Insert one temperature-sensing probe through the septum hole into the vial and manipulate it until it is in contact with the active face of the susceptor material.

6.5 Place vial on its side in the center of the microwave oven, marking the exact location on the oven floor for subsequent replicates. Place the cap of the vial towards the probe access port in the oven cavity, with susceptor active face up.

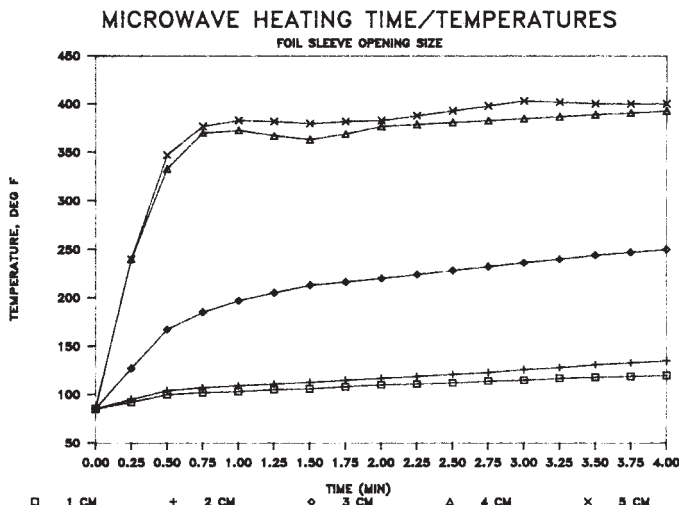
6.6 As an alternative to 6.2 through 6.5, multiple probes can be used for doing temperature profiling, using the following procedure. Cut a 10 by 65-mm portion from the susceptor

<sup>11</sup> Available from Alltech Associates, Inc. 2051 Waukegan Rd., Deerfield, IL 60015 (Catalog No. 9534), or equivalent.

<sup>12</sup> Available from Alltech Associates, Inc., (Catalog No. 95321), or equivalent.



**FIG. 1 Probe Configuration for Popcorn Bag Temperature Measurement**



**FIG. 2 Effect of Foil Sleeve Window Size (cm<sup>2</sup>) on Temperature Attained by Frozen Fish Product Susceptor**