Association of Home Appliance Manufacturers Method for Measuring Performance of *Household Electric Coffee Makers*

ANSI/AHAM CM-1-2005
(Revision of AHAM CM-1-1997)

AHAM
association of home appliance manufacturers

Preface

The Association of Home Appliance Manufacturers develops standards in accordance with AHAM's "Policy and Procedures Governing Technical Standards" which states:

> "AHAM Standards shall be in the best interest, mutually, of consumers who use appliances, the industries which provide and service appliances, and other interested parties. They shall relate to actual use conditions and be technically and scientifically sound.

Use or observance of AHAM standards is voluntary.

This standard contains

> Test procedures which may be applied to any brand or model of household electric coffee maker for measuring performance. Results of tests in accordance with this standard may be publicly stated.
>
> Recommended levels of performance which are considered important to include but which are recommendations only.

With regard to safety, AHAM recommends that all appliance products – both major and portable -- manufactured or marketed in the United States be submitted to an appropriate independent laboratory for inspection and listing in conformance with the safety standards and procedures followed by such laboratories. The relevant standard for household electric coffee makers is ANSI/UL 1082, "Standard for Safety for Household Electric Coffee Makers and Brewing-Type Appliances."

AHAM welcomes comments and suggestions regarding this standard. Any standard may be reviewed and improved as needed. All standards must be updated or reconfirmed at least every five years. Any interested party, at any time, may request a change in an AHAM standard. Such requests should be addressed to AHAM's President, and should be accompanied by a statement of reason for the request and a suggested alternate proposal.

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1. PURPOSE

This standard establishes a uniform, repeatable procedure or standard method for measuring specified product characteristics of household electric coffee makers.

The standard methods provide a means to compare and evaluate different brands and models of household electric coffee makers regarding characteristics significant to product use.

The standard methods (including the recommended levels of performance, where they appear) are not intended to inhibit improvement and innovation in product testing, design or performance.

2. SCOPE

This standard applies to household electric coffee makers as defined in Section 3.

This standard establishes uniform methods for measuring performance. This standard only includes recommended test criteria where necessary to enable tests to be carried out. In addition, recommended performance levels only appear where sufficient technical information is available to include such levels.

3 DEFINITIONS

3.1 Household Automatic Percolator

3.1.1 An electric appliance designed to heat water and brew by recirculation.

3.1.2 The appliance is designed to automatically terminate the brewing cycle when brewing is complete.

3.1.3 The appliance may incorporate means to maintain the beverage at serving temperature on completion of the brewing cycle.

3.2 Household Automatic Coffee Urn

3.2.1 This appliance incorporates all of the features in 3.1 with the following additions.

3.2.2 This appliance is stationary when the beverage is dispensed.

3.3 Household Automatic Drip Coffee Maker

3.3.1 An electric appliance designed to heat water and brew coffee by a single pass through grounds.

3.3.2 The appliance is designed to automatically terminate the brewing cycle.

3.3.3 The appliance may incorporate means to maintain the beverage at serving temperature on completion of the brewing cycle.

3.3.4 The appliance remains stationary throughout its use and the finished coffee beverage is dispensed into a separable container or cavity.

3.4 Household Espresso Maker

3.4.1 An electric appliance whereby pressurized, heated water is forced through coffee grounds**.**

3.4.2 The espresso maker may incorporate means to maintain the beverage at serving temperature on completion of the brewing cycle.

3.4.3 The espresso maker may incorporate means to preheat the water, or to maintain preheated water under pressure prior to preparation of the finished beverage.

3.5 Cup Volume

3.5.1 Brew maximum volume according to manufacturers' instructions.

3.5.2 The manufacturer's cup volume is determined by dividing the final beverage quantity by the number of cups indicated and recorded in fluid ounces (or milliliters).

4. STANDARD TEST CONDITIONS AND INSTRUMENTATION

4.1 Standard Voltage and Frequency. For purposes of this standard, all tests will be conducted at 120 Volts, 60 Hertz (Hz). The test voltage will be measured at the appliance plug when the appliance is energized and will be maintained throughout testing.

4.2 Test Area. Test in an area free of direct drafts and maintained at a temperature of 73 ± 9°F (23 ± 5°C).

4.3 Instrumentation. Electrical measurements must be accurate to within ± 1%.

5. STANDARD METHOD FOR MEASURING PERFORMANCE

5.1 Performance Test Parameters. The following items detail the testing parameters or ambient conditions.

5.1.1 Coffee. Conduct tests using type and amount of coffee defined in the manufacturer's instructions or by the coffee grounds supplier. If a range is specified, the maximum amount of coffee is to be used.

5.1.2 Water Temperature. Fill the coffee maker with water to maximum recommended capacity at 60 ±5°F (15 ±3°C). Use the manufacturer's recommended vessel for filling.

5.1.3 Cup Size. For purposes of conducting performance tests, 5 fluid ounces (150 ml) will be the standard cup size for percolators, urns, and automatic drip coffee makers, unless indicated by the manufacturer. A 2 fluid ounce (60 ml) cup will be the standard cup size for espresso makers.

5.1.4 Beverage Setting. Set the brew strength selector, if incorporated, at the strongest setting**.**

5.1.5 Brew Cycle. Energize the coffee maker and permit to operate until the brewing cycle is completed as defined by the manufacturer's instructions.

5.1.6 Coffee Maker Temperature. The temperature of the unpackaged coffee maker (including all components) should be maintained at an ambient temperature for at least 2 hours (per Section 4.2) prior to testing.

5.1.7 Coffee Filters--Automatic Drip Coffee Makers. Unless otherwise specified in the standard, the testing is to be conducted using coffee filters as specified by the manufacturer in the operating instructions.

5.2 Measuring Levels of Performance

5.2.1 Beverage Temperature on Completion of Brewing--Percolators, Urns and Automatic Drip Coffee Makers. Begin the brew cycle following the manufacturer's recommendations. The beverage temperature in the dispensing vessel of the coffee maker (carafe, mug, etc.) is to be measured using an appropriate temperature probe at the geometric center of the dispensing vessel/carafe while stirring the beverage. Measurements should be taken at the completion of the brewing cycle and at a 2 minute interval after completion of the cycle.

Leave or replace the dispensing vessel/carafe on the warming part (if present). After one hour measure the beverage temperature again as outlined above and record.
It is generally accepted that brewed coffee temperature should be between the range of 170°F and 205°F (77°C and 96°C). The upper finished brew temperature assures that coffee does not reach a boiling point which can affect the taste and aroma. The lower temperature limit assures generally acceptable drinking temperature when pouring into a cold cup, adding cream, sugar and a spoon.

5.2.2 Beverage Temperature on Completion of Brewing--Espresso Makers. On completion of the brewing cycle and within one minute interval, the beverage temperature in the dispensing vessel of the espresso maker should be measured. For appliances which do not include a beverage dispensing vessel, the beverage is to be dispensed into a 250-ml glass laboratory beaker which is initially at 73 ± 9°F (23 ± 5°C). The temperature is to be measured using an appropriate temperature probe at the geometric center of the dispensing vessel/beaker while stirring the beverage.

5.2.3 Accuracy of Output Cup Markings. After determining the cup volume according to Section 3.5, repeat brewing following the manufacturer's instructions at each indicated lower cup volume interval. Record the volume of the beverage brewed and divide by indicated lower cup quantity. Record the variation between the brewed cup volume and the cup volume measured in Section 3.5.

5.2.4 Output Water Temperature. A measurement should be made of the water temperature before the water mixes with the coffee grounds. An appropriate temperature probe should be mounted in the water stream where it exits the coffee maker (or the riser tube in percolators and urns) and travels through air to the grounds. Temperature measurements should be taken every 30 seconds during the brew cycle.

5.2.5 Temperature of the Coffee Grounds. The temperature of the water in the coffee grounds should be measured during the brewing cycle. The temperature probe should be located near the center of the grounds accumulation. Temperature measurements should be taken every 30 seconds during the brew cycle and averaged over the entire cycle.

5.2.6 Pouring Spout Performance. For tip-to-pour coffee makers and carafes, pour out one cupful of brewed coffee, in the normal pouring motion. Normal pouring motion is defined as pouring into a 2 in. (5.08 cm) diameter opening at a rate to approximate filling a 5 oz. cup in 5 seconds. For stationary coffee makers, dispense one cupful of brewed coffee in a normal manner. Measure the amount of liquid (in drops or weight) that spills on the supporting surface and/or liquid that is emitted from the spout after dispensing is stopped. This test should be conducted per the manufacturer's instructions with the coffee maker or dispensing container at maximum fill capacity and then again with less than 2 cups.

5.2.7 Frothing--Espresso Makers. If the appliance is equipped with a frothing wand, with the tip of the frothing wand in the geometric center of a standard 250 ml beaker, operate the appliance according to the manufacturer's instructions.

Measure the total amount of liquid emitted during the first 30 seconds of frothing time.

Measure the amount of time the appliance emits a continuous supply of steam.

Measure the amount of time it takes to double the volume of 3 oz. of milk. For purposes of this test, the milk shall contain no more than 4.7 grams of fat per 1 cup (240 ml) and shall be at 35-40°F at the beginning of the test

5.2.8 Brew Strength. The following tests may be used to evaluate filters, coffee grinds, and consistency of brew strength. This evaluation can be performed using one or more of the following methods.

NOTE: Method 1, Evaporation Method is believed to be the more precise method. However the hydrometer method has been used for many years by a number of organizations with satisfactory results. Although it may not be as accurate due to the effects of lipids in the coffee during the test, it is a quicker and practical method.

5.2.8.1 Method 1--Evaporation Method. After coffee is prepared as per Section 5.1, cool a well-mixed sample of the beverage to 73 ± 9°F (23 ± 5°C). Filter a sample through a filter paper to remove any insoluble sediment or fine grounds. Weigh a small, clean, dry aluminum or glass dish to the nearest tenth of a milligram on an analytical balance. Transfer quantitatively 0.3 oz. (10 ml) of the filtered beverage to the dish. Evaporate the water and dry the residue in a constant temperature oven held at 200 ± 5°F (93 ± 3°C). Evaporation will take at least 3 hours. After drying has been completed, transfer the dish to a desiccator and allow it to cool to the ambient temperature. Reweigh the dish. The difference in weight represents the soluble solids contained in 0.3 oz. (10 ml) of the beverage. Percent soluble solids are obtained by multiplying this figure by 10.

This test should be repeated at full, midpoint and smallest usable indicated volume of brewing capacity.

5.2.8.2 Method 2--Hydrometer.[1] The following procedure is an alternate to the evaporative method for obtaining brew strength.

Equipment Needed:

A. Coffee Hydrometer
B. Glass cylinders
C. Thermometer, capable of reading to 212°F (100°C)--where applicable.

Brew full strength coffee in accordance with the manufacturer's instructions. (Usually one level tablespoon of coffee per cup of water is used in Percolators, Urns or Automatic Drip Coffee Makers.) For Espresso Makers, follow the manufacturer's instructions.

Instructions for the specific hydrometer should be followed. The following will explain the general use of a coffee hydrometer.

Coffee Hydrometer Reading in Hydrometer Units. [2] (See Figure 1) Use a glass cylinder large enough to accommodate the coffee hydrometer and the thermometer and allow it to float. Fill cylinder with coffee once and empty. This is done to get any residue out before the test. After emptying, refill to engraved line with coffee. Allow the coffee to cool to between 160° and 165°F (71° and 74°C). Make sure the cylinder is standing on a level surface, then lower the hydrometer into coffee. Holding the hydrometer at the top, raise and lower the unit in the cylinder to mix the coffee. After the hydrometer has been in the coffee for at least 2 minutes, push the unit to the bottom of the cylinder and allow it to rise. Read the measurement of hydrometer units at the top of the meniscus and immediately read the thermometer. After mixing the coffee, take three separate readings with the beverage between 150°F and 130°F (65.5° and 54.4°C).

Hydrometer Reading Procedure. The liquid will be drawn up slightly around the item and should be read at this point, not at the liquid level away from the stem. (See Figure 1) For best results, the readings should be made at 140°F (60°C). If readings are made at temperatures other than 140°F (60°C), the readings must be corrected to 140°F. Correction may be made by using Table 2. Example: Hydrometer reading = 3.9, Temperature 143°F. Referring to Table 2, across from 143°F, you will see that a correction of 0.88 must be added. Therefore, the corrected reading is 3.9 + 0.88 = 4.75.

If a second sample is to be tested, the cylinder should be cleaned and rinsed using some of the new test coffee. This new coffee should be discarded before conducting the second test.
To convert a hydrometer reading to percent soluble solids, use Table 1. First, find the hydrometer reading on the chart, read to the left column, and add the number at the top of the column. Use the closest hydrometer reading listed on the table. Example: Hydrometer reading at 140°F is 5.27 (5.28 is the closest value on the table). 1.30 is found on the left column and 0.02 is found on the top. Therefore, 1.32 is the percent of soluble solid in the beverage.

[1] Several companies manufacture hydrometers that may be used.

[2] "The Coffee Hydrometer", Rascher & Betzold, Inc. Publication No. 43.

Direct Reading Hydrometer.[3] (See Figure 2) An alternate to the above method is the following method using a direct reading hydrometer. In this method the direct reading hydrometer incorporates the thermometer within the body of the hydrometer unit and the stem is read in percent soluble solids. Follow the instructions as above with a separate coffee hydrometer. Take three readings between 150°F and 130°F (65.5° and 54.4°C) .

Follow the hydrometer manufacturer's instructions for making temperature corrections to the percent soluble solids reading.

5.2.9 Sediment. After the beverage has been prepared as per Section 5.1, it is transferred carefully, including all sediment, to a graduated glass beaker. A magnetic stirring rod is dropped into the beaker and the beverage stirred at a rate that will distribute the sediment uniformly. A sample (approximately 100 ml) is removed and its volume determined accurately to the nearest 0.1 ml. The sampling is then filtered through a pre-dried and pre-weighed filter. For purposes of this test, a filter paper with porosity approximating a Whatman #4, (20-25 micron) may be used. The sampling container is rinsed thoroughly to transfer all sediment to the filter.

The filter is dried to constant weight. The increase in weight is equivalent to the amount of sediment in the sample. The result is recalculated in terms of mg./100 ml of the beverage.

5.2.10 Brew Cycle Time--Percolators and Urns. Record the time from when the unit is actuated until the completion of the brewing cycle as defined by the manufacturer's instructions.

5.2.11 Brew Cycle Time--Automatic Drip Coffee Makers and Espresso Makers. Record the time from when the switch is actuated until there is more than 30 sec. between drips of coffee into the carafe. It may be necessary to hold the drip stop mechanism in the open position, where this feature is present. The brew cycle time is calculated as the total time less the 30 seconds.

Note: For Espresso Makers which include a preheat function, the brew time will include the preheat time. For espresso makers with a capacity greater than 4 cups, the brew time will be the preheat time plus the time to deliver 4 cups. The brew time will not include the frothing time.

[3] "The Direct Reading Coffee Hydrometer", Rascher & Betzold, Publication No. 61.

6. SAFETY

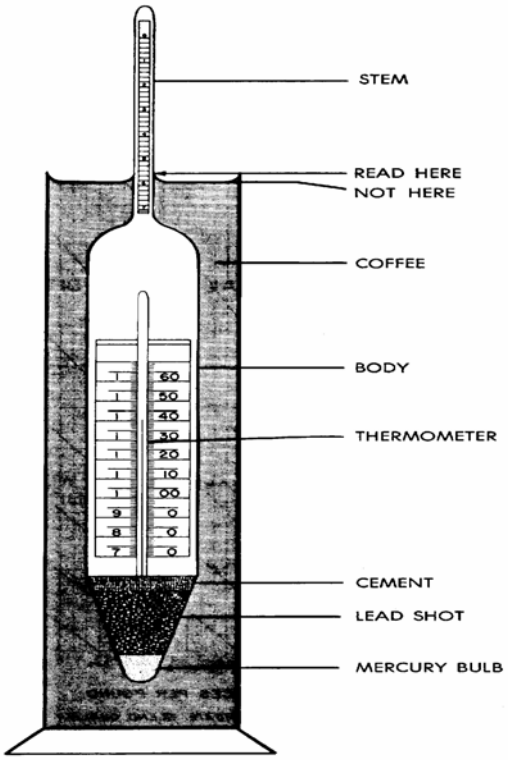
This voluntary standard sets forth methods for conducting performance testing of coffee makers. This standard does not, nor is it intended to, address safety issues associated with the product. It is recommended that electric coffee makers comply with the safety requirements of American National/Underwriters Laboratories Standard (ANSI/UL) No. 1082, "Standard for Safety of Household Electric Coffee Makers and Brewing-Type Appliances," latest edition.

Coffee Hydrometers and Instructions may be obtained from a number of sources including:

Rascher & Betzold
5410 No. Damen Ave.
Chicago, IL 60625

Kessler Instruments Inc.
P.O. Box 640
Westbury, NY 11590

The Whatman filter porosity scale is a Registered Trademark of Whatman Ltd.


STEM
READ HERE
NOT HERE
COFFEE
BODY
THERMOMETER
CEMENT
LEAD SHOT
MERCURY BULB

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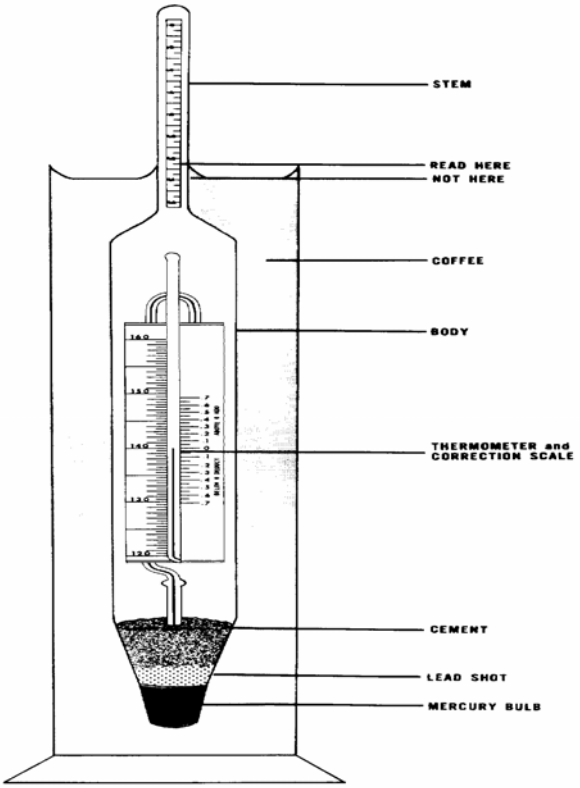
STEM
READ HERE
NOT HERE
COFFEE
BODY
THERMOMETER and
CORRECTION SCALE
CEMENT
LEAD SHOT
MERCURY BULB

5

Table 1
Correlation of Hydrometer Readings at 140° F and Soluble Solids in Beverage Coffee

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.00	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36
0.10	0.40	0.44	0.48	0.52	0.56	0.60	0.64	0.67	0.71	0.75
0.20	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15
0.30	1.19	1.23	1.27	1.31	1.35	1.39	1.43	1.47	1.51	1.55
0.40	1.59	1.63	1.67	1.71	1.75	1.79	1.83	1.87	1.91	1.94
0.50	1.98	2.02	2.06	2.10	2.14	2.18	2.22	2.26	2.30	2.34
0.60	2.38	2.42	2.46	2.50	2.54	2.58	2.62	2.66	2.70	2.74
0.70	2.74	2.82	2.86	2.90	2.94	2.98	3.02	3.06	3.10	3.14
0.80	3.18	3.22	3.26	3.30	3.34	3.37	3.41	3.45	3.49	3.53
0.90	3.57	3.61	3.65	3.69	3.73	3.77	3.81	3.85	3.89	3.93
1.00	3.97	4.01	4.05	4.09	4.13	4.17	4.21	4.25	4.29	4.33
1.10	4.37	4.41	4.45	4.49	4.53	4.57	4.61	4.65	4.69	4.73
1.20	4.76	4.80	4.84	4.88	4.92	4.96	5.00	5.04	5.08	5.12
1.30	5.16	5.20	5.24	5.28	5.32	5.36	5.40	5.44	5.48	5.52
1.40	5.56	5.60	5.64	5.68	5.72	5.76	5.80	5.84	5.88	5.92
1.50	5.96	6.00	6.03	6.07	6.11	6.15	6.19	6.23	6.27	6.31
1.60	6.35	6.39	6.43	6.47	6.51	6.55	6.59	6.63	6.67	6.71
1.70	6.75	6.79	6.83	6.87	6.91	6.95	6.99	7.03	7.07	7.11

$$\text{Percent Soluble Solids} = \frac{\text{Hydrometer Scale Reading}}{3.97}$$

Table 2
Temperature Correction Table
For Coffee Hydrometer

Temperature Reading degrees F	To Correct Hydrometer Reading to 140 degrees F	
130	Subtract	2.75
131		2.49
132		2.21
133		1.94
134		1.66
135		1.38
136		1.10
137		0.83
138		0.55
139		0.27
140		0.00
141	Add	0.29
142		0.59
143		0.88
144		1.18
145		1.47
146		1.76
147		2.06
148		2.35
149		2.65
150		2.96

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