

## **CATEGORY TO STUDY: Microwave Ovens**

### **Overview**

A microwave oven uses electromagnetic energy, similar to radio waves, to produce heat in substances such as food. Microwaves, as they are commonly called, have become essential kitchen appliances. Its ability to cook and reheat quickly has made it a "must-have" in today's kitchen. There are two types of microwave ovens – one being wall and cabinet "built-ins" that are usually placed over a stove/range (known as over-the-range, or OTR, microwaves), and the second being a "countertop" oven. What started as limited function units has now evolved into ovens that can sense when food is done by measuring the steam food emits, turntables to rotate food, and shortcut keys with preset cooking times.

### **A Brief History of Microwave Ovens**

Magnetron tubes were a necessity in World War II to generate "microwaves" for short-range military radar. With the end of the war, makers of these tubes, like Raytheon Technologies, needed to find new applications to replace lost sales due to the war's end. Heating foods was one such application. Using radio waves to heat foods was not a new concept at the time. For example, at the 1933 World's Fair in Chicago, Westinghouse demonstrated cooking steak and potatoes between two metal plates using a 10-kilowatt shortwave radio transmitter (Ackerman, 2016).

The actual evolution of today's microwave, however, started as an accidental discovery from Raytheon engineer Percy Spencer, and it all started with a candy bar. Mr. Spencer was visiting his magnetron lab with his favorite chocolate bar in his pocket. While standing in front of an active radar set, he realized suddenly realized he had a pocketful of melted chocolate. This accident led him to investigate other foods, starting with popcorn that exploded all over the lab when it was near the magnetron. Next, he moved to eggs. For this trial, he cut a hole in the side of a kettle, inserted an egg (still in its shell), and placed a magnetron over the hole to direct microwaves into the kettle. The result? A doubting fellow engineer peeped into the kettle and got a face full of exploding egg! Those two cooking experiments prompted Spencer and Raytheon to file for a patent in 1946 to use microwaves to cook food (Ackerman, 2016; ETHW, 2017).

Raytheon introduced the first commercial Radarange microwave oven in 1946. The target market for this very large appliance was restaurants and airlines to reheat meals on airplanes. Microwaves for consumer use were scaled down in size and first available in 1955 when Raytheon licensed their microwave technology to Tappan. Tappan's RL-1 was a wall-mounted unit, but its high cost of \$1,295 (equivalent to approximately \$13,000 in 2021) made it unaffordable for most consumers. Raytheon, however, did not abandon its pursuit of a consumer-based unit. They acquired the Amana Refrigeration company in 1965, followed by introducing the Amana Radarange in 1967 at the more affordable but still expensive price of \$495 (equivalent to almost \$5,000 in 2021 dollars) (Ackerman, 2016).

For this appliance to "cook" food, the electron tube (i.e., magnetron) generates "microwaves," causing water molecules to vibrate. This action causes the water molecules to bump into one another (i.e., friction) and other food molecules, such as protein and fat, producing heat and increasing the food's temperature. The "microwaves" first hit the food's exterior, with heat produced from the friction to the interior of the food (Sargianis, 2019). At one point, consumers were worried about radiation from microwaves being harmful to human health. However, "microwaves" emitted by this appliance produce

non-ionizing radiation that doesn't have the same risks as radiation from ionizing sources. Plus, the FDA has strict safety standards that manufacturers must meet (FDA, 2020).

Microwave cooking does have its limitations as it cannot produce crispy, brown crusts – you still need your conventional oven for this (ETHW, 2017). Despite these limits, today, microwave ovens are one of the most heavily used kitchen appliances, from reheating a cup of coffee to cooking a frozen dinner and more.

### **Selection Factors**

(Consumer Reports, 2021; Farrell, 2021; Lake Abdelrahman, 2019)

There are several factors to consider when deciding which microwave to purchase.

Type – over-the-range (OTR)/Built-In vs. countertop model

- Countertop microwave – as the name implies, this model sits on the countertop or a cart and just needs to be plugged in to use; most common and most affordable
- OTR or built-in model – this model frees up counter space but requires installation, possibly by a professional; they stay with the home – you do not take these with you when you move

Size/dimensions – consider height, width, and depth to confirm the unit will fit in the desired space

Capacity – how much space is in the interior of the microwave; usually ranges from 0.5 cubic feet (large enough for a dinner plate) to up to 2 cubic feet, with 1 to 2 cubic feet being the most common

Wattage -- more watts typically means faster, more even cooking; however, a 100-watt difference does not matter much

Cooking quality --

- Speed food is defrosted/heated
- How evenly food is heated

Predicted reliability -- manufacturers say microwaves should last at least ten years

Owner satisfaction

Cost -- countertop microwaves cost less than other types, with costs starting as low as \$50. Built-ins can cost between \$200 to over \$1000








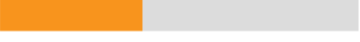


Other features --





- Turntables and trays – rotates the food for more even cooking
- Quick keys -- 30-second or 1-minute presets, for example
- Automatic cooking and/or defrost – senses how long it will take for the item to cook or defrost
- Racks – allow cooking of multiple dishes/food items at the same time
- Shortcut keys -- preset buttons from cooking popular foods)
- Convection cooking, grilling, and browning – these cooking functions are not available in traditional microwaves
- Child lock – prevents children from opening the door and possibly getting burned from hot food
- Communication with a virtual assistant device like Alexa

## References

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- Lake Abdelrahman, A. (2019, April 30). Here's exactly what to look for before buying a microwave oven, according to kitchen experts. Retrieved June 28, 2021, from Good Housekeeping website: <https://www.goodhousekeeping.com/appliances/microwave-reviews/a12766/microwave-faqs-0306/>
- Sargianis, K. (2019, June 17). Your microwave questions answered. Retrieved June 28, 2021, from Cook's Illustrated website: [https://www.cooksillustrated.com/articles/1762-your-microwave-questions-answered?extcode=MASCD00L0&ref=new\\_search\\_experience\\_5](https://www.cooksillustrated.com/articles/1762-your-microwave-questions-answered?extcode=MASCD00L0&ref=new_search_experience_5)

# SAMPLE CLASS MICROWAVE OVENS:

Type/model/cost/description	Consumer Reports Rating
<p><b>1. Mid-sized countertop model</b></p>  <p><b>Panasonic NN-SN67HS</b></p> <p>Price <b>\$140.00</b> <a href="#">Shop</a></p> <p><u>Description:</u>            External dimensions: Height = 12 in; Width = 20 in; Depth = 16 in            1.2 cubic-foot capacity            1200-watt            Features:  <ul style="list-style-type: none"> <li>• a sensor</li> <li>• auto-defrost</li> <li>• touchpad controls</li> </ul> </p>	<p><b>PREDICTED RELIABILITY</b> <small>i</small>  <b>3 / 5</b></p> <p><b>HEATING EVENNESS</b> <small>i</small>  <b>4 / 5</b></p> <p><b>DEFROSTING EVENNESS</b> <small>i</small>  <b>5 / 5</b></p> <p><b>SPEED OF HEATING</b> <small>i</small>  <b>5 / 5</b></p>
<p><b>2. Large countertop model</b></p>  <p><b>Samsung MS14K6000AS</b></p> <p>Price <b>\$170.00</b> <a href="#">Shop</a></p> <p><u>Description:</u>            External dimensions: Height = 12 in; Width = 22 in; Depth = 17 in            1.4 cubic-foot capacity            1000-watt            Features:  <ul style="list-style-type: none"> <li>• a sensor</li> <li>• auto-defrost</li> <li>• touchpad controls</li> </ul> </p>	<p><b>PREDICTED RELIABILITY</b> <small>i</small>  <b>3 / 5</b></p> <p><b>HEATING EVENNESS</b> <small>i</small>  <b>2 / 5</b></p> <p><b>DEFROSTING EVENNESS</b> <small>i</small>  <b>4 / 5</b></p> <p><b>SPEED OF HEATING</b> <small>i</small>  <b>3 / 5</b></p>

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<p><b>3. Built-in model</b></p>  <p><b>KitchenAid KMBD104GSS</b>  Price \$1,440.00 <a href="#">Shop</a></p> <p><u>Description:</u>  External dimensions: Height = 16 in; Width = 24 in; Depth = 23 in  1.2 cubic-foot capacity  950-watt  Features:  <ul style="list-style-type: none"> <li>• a sensor</li> <li>• auto-defrost</li> <li>• touchpad controls</li> </ul> </p>	 <table border="0"> <tr> <td>PREDICTED RELIABILITY <small>i</small></td> <td><div style="width: 40%; background-color: orange;"></div></td> <td>2 / 5</td> </tr> <tr> <td>HEATING EVENNESS <small>i</small></td> <td><div style="width: 60%; background-color: yellow;"></div></td> <td>3 / 5</td> </tr> <tr> <td>DEFROSTING EVENNESS <small>i</small></td> <td><div style="width: 80%; background-color: lightgreen;"></div></td> <td>4 / 5</td> </tr> <tr> <td>SPEED OF HEATING <small>i</small></td> <td><div style="width: 60%; background-color: yellow;"></div></td> <td>3 / 5</td> </tr> </table>	PREDICTED RELIABILITY <small>i</small>	<div style="width: 40%; background-color: orange;"></div>	2 / 5	HEATING EVENNESS <small>i</small>	<div style="width: 60%; background-color: yellow;"></div>	3 / 5	DEFROSTING EVENNESS <small>i</small>	<div style="width: 80%; background-color: lightgreen;"></div>	4 / 5	SPEED OF HEATING <small>i</small>	<div style="width: 60%; background-color: yellow;"></div>	3 / 5
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<p><b>4. Over-the-range model</b></p>  <p><b>Whirlpool WMH54521JZ</b>  Price \$400.00 <a href="#">Shop</a></p> <p><u>Description:</u>  External dimensions: Height = 17 in; Width = 30 in; Depth = 16 in  2.1 cubic-foot capacity  1000-watt  Features:  <ul style="list-style-type: none"> <li>• a sensor</li> <li>• auto-defrost</li> <li>• touchpad controls</li> <li>• wire rack for bi-level cooking</li> </ul> </p>	 <table border="0"> <tr> <td>PREDICTED RELIABILITY <small>i</small></td> <td><div style="width: 100%; background-color: green;"></div></td> <td>5 / 5</td> </tr> <tr> <td>HEATING EVENNESS <small>i</small></td> <td><div style="width: 100%; background-color: green;"></div></td> <td>5 / 5</td> </tr> <tr> <td>DEFROSTING EVENNESS <small>i</small></td> <td><div style="width: 100%; background-color: green;"></div></td> <td>5 / 5</td> </tr> <tr> <td>SPEED OF HEATING <small>i</small></td> <td><div style="width: 80%; background-color: lightgreen;"></div></td> <td>4 / 5</td> </tr> </table>	PREDICTED RELIABILITY <small>i</small>	<div style="width: 100%; background-color: green;"></div>	5 / 5	HEATING EVENNESS <small>i</small>	<div style="width: 100%; background-color: green;"></div>	5 / 5	DEFROSTING EVENNESS <small>i</small>	<div style="width: 100%; background-color: green;"></div>	5 / 5	SPEED OF HEATING <small>i</small>	<div style="width: 80%; background-color: lightgreen;"></div>	4 / 5
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## Scenario

Pablo's mom is updating the kitchen. She would like to free up space on the counter and put a microwave over the stove, though she's not opposed to just replacing her current microwave with another countertop model. The family uses their microwave frequently to defrost, cook and reheat foods. They are a very busy family so the quicker their meals can be cooked or heated, the better but the food has to be heated evenly. Pablo's mom also wants to make sure they have a brand and model that will last. She's willing to spend up to \$375, so she wants her investment to be worth it.

### STANDARDS

ALTERNATIVE SOLUTIONS	COSTS \$375 OR LESS	Defrosts	Heats up evenly and quickly	Built-in or Countertop model
1. Panasonic NN-SN67HS	\$140.00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Countertop
2. Samsung MS14k600AS	\$170.00	<input checked="" type="checkbox"/>	?	Countertop
3. KitchenAid KMBD104GSS	\$1440.00	<input checked="" type="checkbox"/>	?	Built-In
4. Whirlpool WMH54521JZ	\$400.00	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Over the range

### **Placement: 4-1-2-3**

The Whirlpool microwave oven (#4) was ranked first for several reasons: 1) it's a built-in model, so it frees up at least 20 inches of space on the countertop; 2) it gets very high marks for reliability, defrosting, and heating, and it includes a rack that allows cooking multiple foods on two levels, which means speedier meal preparation. The one drawback to the Whirlpool model is that it is over budget, but not by much. Second in the rankings is the Panasonic unit (#1). It's very reasonably priced and receives very good reviews. The drawback is the counter space it will take up. The Samsung (#2) takes up more counter space and gets very mediocre reviews, as does the KitchenAid (#3), which costs more than three times more than the Whirlpool.

Additional information on the quality of brands can be obtained from *Consumer Reports*

[www.ConsumerReports.org](http://www.ConsumerReports.org)