



# Radiation Emissions from Microwave Ovens

Microwave ovens use microwave radiation to cook food, either in the home or in commercial or other premises. There is no evidence to suggest that microwave ovens when used according to the manufacturer's instructions, and maintained in good working order will be a radiation hazard. Some features of microwave ovens and precautions in their use are described below.

The Australian Radiation Protection and Nuclear Safety Agency monitors potential radiation hazards arising from consumer products and equipment used in industry and evaluates possible public radiation health risks arising from their use.

## What are Microwaves?

Microwaves, like visible light, are a part of the electromagnetic radiation spectrum. They are extremely high frequency radio waves. As the frequency of radiation increases, its wavelength decreases, so very high frequencies correspond to very short wavelengths; hence the name microwaves. Infrared radiation, ultraviolet light and X-rays are also electromagnetic radiations, but have even shorter wavelengths than microwaves.

Microwaves may either be reflected, transmitted or absorbed by matter in their path. Metallic materials totally reflect microwaves. Most non-metallic materials such as glass and plastics are partially transparent to microwaves. Material containing moisture, such as food and even people, absorbs microwave energy. If energy is absorbed at a rate greater than the rate at which the material loses energy (ie. rate of cooling), its temperature will increase.

## What are Microwaves used for?

Some of the more common uses of microwaves include satellite communications, mobile phones, radar, air and sea navigational aids. Other applications include industrial heating and therapeutic diathermy treatment.

The use of microwave ovens in industrial, commercial, domestic and other premises has increased substantially over recent decades. This brochure refers only to domestic-type microwave ovens intended for use in the home or workplace staff rooms.

## How do Microwave Ovens work?

In the microwave oven, an electronic device called a magnetron is used to produce the microwaves. These microwaves have a frequency of 2,450 MHz<sup>1</sup>. The microwaves then pass into the

<sup>1</sup> MHz is an abbreviation for Megahertz; 1 MHz is one million cycles of electromagnetic wave oscillations per second.

enclosed metal oven cavity where they are reflected around the oven walls and absorbed in food or drink placed in the oven. Uneven absorption may cause localised 'hot spots'.

The microwaves penetrate the food or liquid and agitate the water molecules within. This causes molecular friction, which produces heat and results in a rapid rise in temperature. Cooking time is usually much shorter than in a conventional oven. The rate of heating depends on the moisture content, shape, volume and mass of food present. Uneven heating can occur in some foods where the outside may be only warm while the inside may be close to boiling (jam filled donuts or meat pies are examples). In other foods, some parts will be cooked, while others are not. Some parts of frozen food may remain frozen if insufficient time is allowed for the heating process.

The oven walls and most non-metallic cooking utensils are not directly heated by microwaves because they do not absorb microwave energy. However, the inside of the oven will feel warm due to the presence of the hot food and heat from the electrical circuits.

## What are the health issues of Microwave exposure?

Exposure to sufficiently high levels of microwaves will cause heating. In the case of human tissue, excessive heating could have serious health effects such as deep tissue burns and hyperthermia. The purpose of Australian Standards is to avoid all known adverse health effects by limiting exposures to levels below those at which heating occurs.

Extensive research has provided no substantiated evidence that microwave exposure, at any level, either causes or promotes cancer.

## How safe are Microwave Ovens?

Microwaves generated in microwave ovens cease to exist once the electrical power to the magnetron is turned off (like visible light from light globes). They do not remain in the food when the power is turned off. Neither can they make the food or the oven radioactive. Therefore, food cooked in a microwave oven is not a radiation hazard.

All microwave ovens have at least two safety interlock switches which stop the generation of microwaves immediately the door is opened. The design of modern microwave ovens is such that the microwaves should be contained within the oven, but it is still possible for some leakage to occur around the doors of certain microwave ovens. Generally, the required design of oven doors

should restrict this leakage to a level well below that recommended by the *Australian/New Zealand Standard AS/NZS60335.2.25:2002 Household and similar electrical appliances – Safety Part 2.25: Particular requirements - Microwave ovens*.

The Standard specifies a test to assess the level of microwave leakage and states that 'The microwave leakage at any point 50 millimetres or more from the external surface of the appliance shall not exceed 50 watts per square metre'. This Standard applies to ovens designed for domestic applications, even if used in a workplace. The recommended limit is conservative and includes significant safety factors, so that even leakage levels appreciably above the limit will have no known effect on human health.

Surveys by organisations providing testing services have shown that microwave oven leakage levels in excess of the recommended limits are rare and an oven in good condition and used correctly is safe. If an oven appears damaged, it should not be used until a suitably experienced technician has tested the oven and checked that the leakage does not exceed the recommended limit. Routine testing of microwave oven leakage is not considered necessary.

For more information on microwave oven leakage see *Advanced Measurements of Microwave Oven Leakage* (Conference Paper) available from ARPANSA's website at [www.arpansa.gov.au/pubs/emr/microwave.pdf](http://www.arpansa.gov.au/pubs/emr/microwave.pdf).

## Cardiac Pacemakers

Even when very close to a microwave oven, modern pacemakers are not likely to be susceptible to interference where leakage levels are within the recommended limits. Persons with pacemakers should obtain and rely on their own medical advice in this respect. Additional advice is available from the Therapeutic Goods Administration.

## Cooking Containers and Foils

Plastic containers considered suitable for holding foods at room temperature may not necessarily be suitable for use in a microwave oven. The high cooking temperatures may cause the plastic's chemistry to break down and thereby contaminate food in the container. Since it is difficult to determine the composition of plastic from its appearance, it is recommended that plastic containers or films not be used in a microwave oven unless specifically designated for such use. Any questions about such products should be directed to the manufacturer.

Most ceramics, glass-ceramics, some plastics and papers are satisfactory for microwave oven use. Dishes with metallic glazes should not be used. If fast food foil containers and aluminium foil are used, the oven manufacturer's directions should be carefully followed. Do not let fast food foil containers or aluminium foil touch the sides of the oven as this may cause sparking.

## Inspection by the user

A microwave oven should only be used if an inspection confirms all of the following points:

- The surface of the door is not damaged.
- The door fits squarely and securely and opens and closes smoothly.
- The door hinges are in good condition.
- The oven is clean and in particular the door edges and interior surrounds are not covered with food or burnt material.
- No corrosion is evident on the door, the door hinges or the oven interior.

## Precautions for radiation safety in the use of Microwave Ovens

- **Follow the oven manufacturer's instructions on recommended operating procedures and safety precautions.**
- Never tamper with or inactivate the interlocking devices.
- Never use the oven without the trays provided by the manufacturer unless specifically allowed in the manufacturer's instructions.
- Never operate the oven without a load (ie. an absorbing material such as food or water) in the oven cavity unless specifically allowed in the manufacturer's instructions.
- Never rest heavy objects such as food containers on the door while it is open.
- Clean the oven cavity, the door and seals with water and a mild detergent at regular intervals (do not use abrasive cleaning pads).
- Supervise children using microwave ovens.

## Other precautions for the safe use of Microwave Ovens

- It is sometimes possible to super-heat some liquids or foods beyond their natural boiling point. Such super-heated liquids may boil suddenly and violently when jolted or stirred after removal from the oven – it is therefore a good idea to take precautions such as covering the food or liquid or allowing it cool before removal from the oven.
- When thawing frozen foods in the microwave oven it is important to thaw the food thoroughly before cooking.
- Care should be taken when sterilising baby bottles or other food utensils.
- Ensure that all food prepared in a microwave oven is stirred and/or left to stand for a few minutes before consuming. In particular, care must be exercised when heating a baby's bottle. Even though the glass bottle may be cool to the touch, the milk could be very hot. Cases have been reported where babies have received severe burns from drinking liquids taken directly from a microwave oven. To avoid problems do not heat baby's liquids in a microwave oven. If there are no alternative means, thoroughly shake the bottle to mix the contents and test its temperature against the skin after heating.