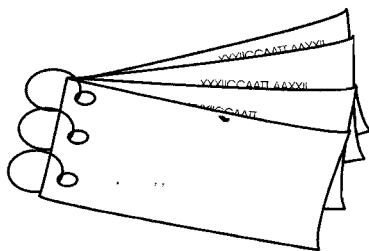


## UNIT 7 TEMPERATURE CONTROL

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- Good temperature control of foods is fundamental to the safe operation of many food businesses.
- The stages in the food production chain (after primary production) subject to temperature control regulations include: Preparation, handling, processing, packaging, manufacturing, storage, transporting, selling, distribution, supplying.
- Regulations state that foods that need temperature control must be held either hot ( $>$  or  $= 140^{\circ}\text{F}$  or  $60^{\circ}\text{C}$ ) or chilled ( $>$  or  $= 45^{\circ}\text{F}$  or  $7^{\circ}\text{C}$ ).

### 7.1 Foods Requiring Temperature Control

- Potentially hazardous foods (PHFs) require temperature control because they might support the growth of harmful (pathogenic) bacteria or the formation of toxins.
- PHFs requiring temperature control include: dairy products, cooked products, smoked or cured ready-to-eat meat or fish, prepared ready-to-eat foods, uncooked or partly cooked pastry and dough products.

### 7.2 The Danger Zone

- Bacteria grow most rapidly in the range of temperatures between  $40^{\circ}\text{F}$  ( $5^{\circ}\text{C}$ ) and  $140^{\circ}\text{F}$  ( $60^{\circ}\text{C}$ ) doubling in number in as little as 20 minutes. This range of temperatures is often called the Danger Zone.
- Food should never be left out of the refrigerator when room temperatures are  $90^{\circ}\text{F}$  ( $32\text{--}33^{\circ}\text{C}$ ). If food has been left out for less than 2 hours, refrigerate or use immediately. If food has been left out for between 2-4 hours, use immediately. If food has been left out for more than 4 hours, throw it out.

- Raw foods especially meat and poultry should always be cooked to a safe internal temperature. Temperatures reached in baking, roasting, frying and boiling will destroy bacteria that can cause food-borne illness.

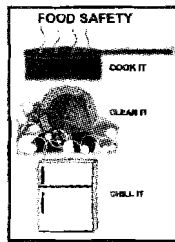
### 7.3 Effects of Temperature on Bacteria

- Bacteria have a minimum, optimum and maximum temperature for growth and can be divided into three groups based on optimum growth temperature: Psychrophiles, mesophiles, thermophiles.
- Pathogenic bacteria can grow rapidly on foods that are capable of supporting their growth in the Temperature Danger Zone (TDZ).
- Therefore, when PHFs are heated or cooked, the food handler must pass these foods through the TDZ as quickly as possible. The total exposure time adds up every time the food is brought back into TDZ or more than 4 hours cumulative (total) time.
- The growth potential of bacteria under various conditions is shown in the following table.

EFFECTS OF TEMPERATURE ON BACTERIA			
Commercial canning temperatures (can only be obtained under pressure)	250°F 240°F	122°C 116°C	Food products essentially sterile. <i>C. botulinum</i> spores destroyed. <i>S. aureus</i> toxin not inactivated at these temperatures.
Water boils	212°F	100°C	Spores of <i>C. botulinum</i> and <i>C. perfringens</i> can survive for hours. Toxin of <i>C. botulinum</i> inactivated.
	165°F	74°C	Most bacteria die; some spore-forming bacteria survive.
Keep food safe	140°F or above OR 45°F or below	60°C or above OR 5°C or below	No bacterial growth; some survive
Hottest temperature hands can endure	125°F	52°C	
Body temperature	98.6°F	37°C	
Room temperature	68 to 77°F	20 to 25°C	
	45°F	7°C	Some bacterial growth
Water freezes	32°F	0°C	No bacterial growth; many survive
	0°F	-18°C	Slow death for many bacteria; some survive

## 7.4 Time-Temperature Control Process

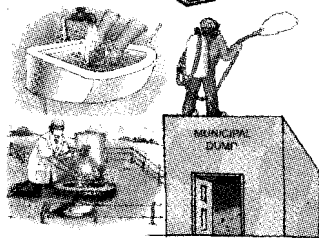
- Limiting bacterial growth is done by a time-temperature control process. This process is critical during thawing, holding, preparation, cooking and during the transportation of foods.
- Potentially hazardous ingredients for foods that will be consumed without further cooking (salads, sandwiches, filled pastry products, etc.), reconstituted and fortified foods must be pre-chilled to 7°C (45°F) or below prior to preparation. Failure to do so may contribute to increased bacterial growth.
- Thaw food in the microwave or in the refrigerator. Do not thaw items on the kitchen counter. This allows bacteria to grow in the outer layers of the food before the inside thaws. If you plan to marinate food, do it in the refrigerator too.



- Thorough cooking kills harmful bacteria. Salmonella can grow inside fresh, unbroken eggs. Hence eggs must not be eaten raw or partially cooked. If foods are prepared and cooked, ahead of time, large portions should be divided into small, shallow containers and refrigerated. This ensures rapid, safe cooking.



- PHFs must be cooled from any temperature below 60°C to 7°C (140°F to 45°F) or below within 4 hours. Adding eatable ice or using an ice water bath while stirring frequently can be helpful. The thickness of distance to centre of food mass has the greatest influence in cooling rate. Hot products should be quickly separated into serving portions and racked, if possible. Hot liquid-like food masses should be containerized and then cooled in shallow pans of  $\leq 4$  inches deep with a food depth of  $\leq 2$  inches high.



- Remember that hot holding should be at 60°C or above (140°F or above) and cold holding 7°C or below (45°F or below). Frozen food must be held in the frozen state in such a manner as to preclude thawing.

- Leftovers must be put in shallow containers, for quick cooking and refrigerated within two hours.



- Thawing at room temperature is not acceptable. The following methods of thawing potentially hazardous foods are acceptable:

- in the refrigerator with  $\leq 5$  °C (40° F);
- under potable (drinkable) running water of  $\leq 21$ °C(70° F) in the food prep sink in the microwave oven, followed immediately by cooking to the proper internal temperature either by conventional cooking processes or in the microwave oven;
- by cooking the frozen food mass as is (cannot be done in microwave oven if food mass is large)

- Reheating foods should be done thoroughly to an internal temperature of 74°C (165°F) or until hot and steaming in the microwave oven, cover food and rotate so it heats evenly. A two minutes stand time should be allowed.

- Cold storage retards bacterial growth. Properly handled food stored in a freezer at  $-17^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) will always be safe. A temperature of  $4.5^{\circ}\text{C}$  ( $40^{\circ}\text{F}$ ) should be maintained in the refrigerator. In contrast to freezer storage, perishable foods will gradually spoil in the refrigerator.
- The same temperature conditions mentioned earlier also apply when PHFs are being transported. In order to ensure proper food temperature sufficient temperature controlling equipment must be provided.

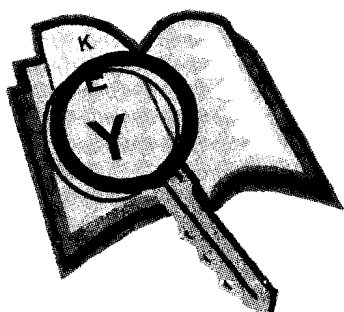
## 7.5 General Recommendations

The following table shows the basic requirements of the legislation and recommendations/ advice.

	Legislation	Recommendation / Advice
Chilled food	<p>Food may not be stored at a temperature above <math>7^{\circ}\text{C}</math> (<math>45^{\circ}\text{F}</math>) if it is likely to support the growth of pathogenic organisms or the formation of toxins</p> <p>If a lower storage temperature is specified by the Manufacturer, the food must be stored at that lower temperature provided it is necessary for the safety of the food.</p> <p>Cold food on display for service can be out of temperature control for one period up to a maximum of 4 hours. After the 4 hour period has expired food must be stored under temperature control or discarded.</p>	<p>Regularly check the temperature of all refrigerators to ensure that they are operating below <math>7^{\circ}\text{C}</math> (<math>45^{\circ}\text{F}</math>) and record this check.</p> <p>Check the manufacturers storage guidelines upon receipt of the food and ensure that the guidelines are followed.</p> <p>Any item of food can be displayed out of temperature control only once. It is good practice to record when the food went on display and when it had finished being displayed as the burden of proof is upon the caterer.</p>
Hot cooked / reheated food		<p>It is good practice to check the temperature of hot reheated or cooked food using a calibrated temperature probe to ensure that it has reached a temperature that will destroy pathogenic microorganisms. It is</p>

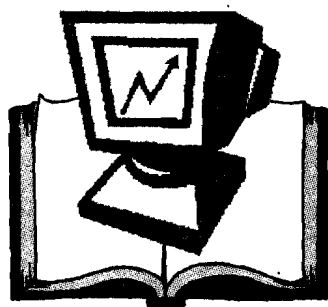
Table contd.

	Legislation	Recommendation / Advice
		also recommended that food is cooked to a temperature of 71°C (158°F) for 2 minutes or an equivalent temperature and time e.g. 75°C (166°F) for 30 seconds and cooking or reheated food temperatures are recorded.
Hot-Held Food	<p>Hot food should be displayed or stored at a temperature of 63°C (145°F) or above.</p> <p>Food may be kept at a temperature cooler than 63°C (145°F) for one period of up to a maximum of 2 hours if it is for service or display.</p>	<p>It is good practice to monitor the temperature of food during the display period using a calibrated thermometer to ensure that it is above 63°C (145°F) and to record this check.</p> <p>If the food is kept below 63°C (145°F) it is advisable to record when the food was put on display and when it was taken off display as the burden of proof is on the caterer.</p>



### Key Terms

**Calibration:** Process of adjusting the output or indication on a measurement instrument to agree with value of the applied standard, within a specified accuracy. For example, a thermometer could be calibrated so the error of indication or the correction is determined, and adjusted (e.g. via calibration constants) so that it shows the true temperature in Celsius at specific points on the scale



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