



# FICSI

Food Industry Capacity and Skill Initiative

# Participant Handbook

Sector

**Food Processing**

Sub-Sector

**Multisectorial**

Occupation

**Refrigeration**

Reference ID: FIC/Q7004, Version 3.0

**NSQF level 3**



## Cold Storage Technician

## **Published by**

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**Shri Narendra Modi**  
Prime Minister of India

“ Skilling is building a better India.  
If we have to move India towards  
development then Skill Development  
should be our mission. ”



## Certificate

### COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

**FOOD INDUSTRY CAPACITY & SKILL INITIATIVE**

for

**SKILLING CONTENT: PARTICIPANT HANDBOOK**

Complying to National Occupational Standards of

Job Role/ Qualification Pack: 'Cold Storage Technician' QP No. 'FIC/Q7004, NSQF Level 3'

Date of Issuance: September 30<sup>th</sup>, 2021

Valid up to: September 29<sup>th</sup>, 2024

\* Valid up to the next review date of the Qualification Pack

Authorised Signatory  
(Food Industry Capacity & Skill Initiative)

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This participant handbook is dedicated to all the aspiring youth who desire to achieve special skills which would be a lifelong asset for their future endeavors and help them make a bright career in the Food Processing Sector.

FICSI is thankful to all organisations and individuals who have helped us in preparation of this participant handbook.

We also wish to extend our gratitude to all those who reviewed the content and provided valuable inputs for improving the quality, coherence, and content presentation of chapters.

## About this book

This book is designed to provide skill training and/or upgrade the knowledge and basic skills to take up the job of a 'Cold Storage Technician' in the 'Food Processing' sector. All the activities carried out by a specialist are covered in this course. Upon successful completion of this course, the candidate will be eligible to work as a Cold Storage Technician.

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational Standards (NOS) is covered across the Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

1. FIC/N7010: Prepare and maintain work area and refrigeration requirements
2. FIC/N7011: Handle cold storage facility for storing food
3. FIC/N7012: Complete documentation and record keeping related to the cold storage facility
4. FIC/N9003: Food safety hygiene and sanitation for storage
5. DGT/VSQ/N0101: Employability Skills

## Symbols Used



Key Learning  
Outcomes



Unit  
Objectives



Exercise



Notes



Practical

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# 1. Introduction

Unit 1.1 - Introduction to the Training Programme

Unit 1.2 - Introduction to the Food Processing Industry

Unit 1.3 - Packaging of Food Products and Cold Storage

Unit 1.4 - Attributes of a Cold Storage Technician



## Key Learning Outcomes



**At the end of this unit, the trainee will be able to:**

1. Explain the purpose of training
2. Discuss the National Occupational Standards and Qualification Pack
3. Define food processing
4. List the various sectors of the food processing industry
5. Describe the various stages of food processing for converting raw materials to food products
6. State the types and categories of packaging of food products
7. List the different products preserved in modified temperature
8. State the use of cold storage for food products
9. State the roles and responsibilities of a Cold Storage Technician

## UNIT 1.1: Introduction to the Training Programme

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. Explain the purpose of training
2. Discuss the National Occupational Standards and Qualification Pack.

### 1.1.1 Purpose and Benefits of the Training Programme

This training programme is developed to impart specific skills to individuals who wish to be a Cold Storage Technician. The training programme is based upon the National Occupational Standards for the food processing sector. The National Occupational Standards have been described in the following subsection of this chapter.

The training programme will enable an individual to:

- handle the installation of refrigeration systems and components;
- handle the storage of food in the cold storage room by maintaining storage parameters;
- work effectively in a team to deliver desired results at the workplace;
- work according to personal health, safety, and environmental protocols at the food processing site.

After successful completion of training and passing the assessment, you will be issued a certificate.



Fig. 1.1.1. Skill cards

## 1.1.2 Introduction to QP and NOS

This training programme is intended to impart basic skill and knowledge relevant to the job role, required to be performed in the food processing industry. This programme is based on a qualification pack called Cold Storage Technician. The Qualification Pack Code for Cold Storage Technician is FIC/Q7004. This is also called a QP.

A QP consists of a set of National Occupational Standards (NOS). NOS specify the standard competency a worker must achieve when carrying out a function at the workplace.

Under the Cold Storage Technician QP, there are four NOSs which detail the functions to be performed at the work site as a Cold Storage Technician.

NOS Code	Major Function/Task
FIC/N7010	Prepare and maintain work area and refrigeration requirements
FIC/N7011	Handle cold storage facility for storing food
FIC/N7012	Complete documentation and record keeping related to the cold storage facility
FIC/N9003	Food safety hygiene and sanitation for storage
DGT/VSQ/N0101	Employability Skills

## UNIT 1.2: Introduction to the Food Processing Industry

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. Define food processing
2. List the various sectors of the food processing industry
3. Describe the various stages of food processing for converting raw materials to food products.

### 1.2.1 Food Processing

Agriculture is the backbone of the Indian economy. The produce from various agriculture-based occupations is primarily used for consumption within the country. It is exported to different parts of the world as well. Agricultural produce is also used as raw material in the food processing industry.

Food processing is the method used to convert raw materials into food products. They could be processed foods, ready-to-eat foods, food additives or foods used to prepare other food products. Besides food processing, the food industry also relies on food preservation as an important method to store food products for longer periods of time.

The food processing industry in India is divided into several sub-sectors. They are:

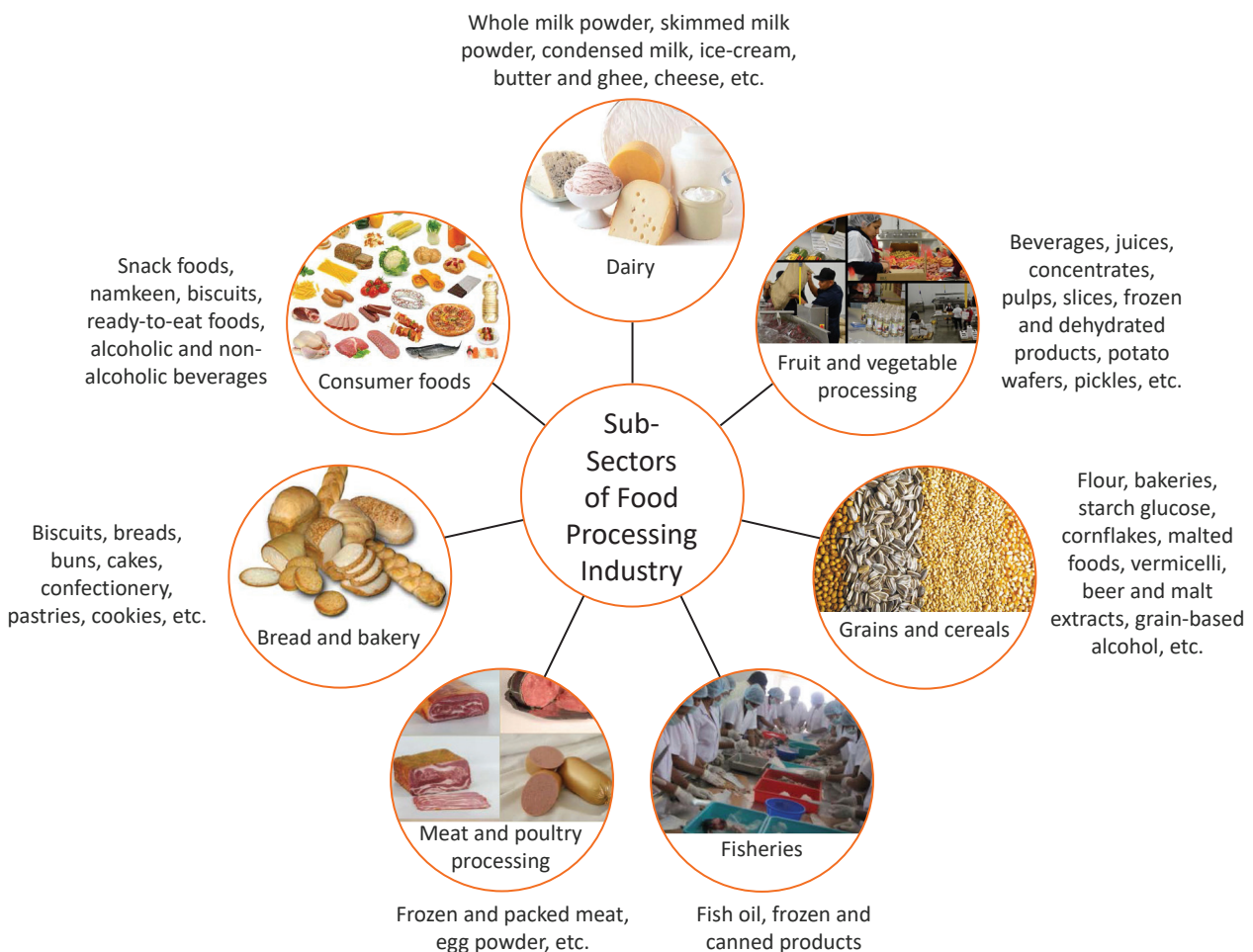


Fig. 1.2.1. Sub-sectors of food processing industry

The Indian food industry is a star sector in India with a bright prospect for growth and development. Indian food and grocery market is the sixth-largest in the world. Food industry, particularly the food processing sector in India, has shown immense potential due to its quick-paced growth. Food processing ranks fifth in the country in terms of its production, growth, export, and consumption. One of the recent trend that is seen in this sector is ordering food online. Even though this segment is still in its early stages of development, it is growing at an increasingly fast pace.

Food industry is implementing stringent food safety and quality measures in order to attract more investors and ensure the safety of its existing consumers. All these factors will have a positive impact on the way the sector functions and also on the job market in the country.

Women have always been associated with preparing food for the family or the household, but in modern times women are breaking this stereotype and turning entrepreneurs in this sector. Women are also becoming professional chefs and bakers, and contributing to the economy and towards the sector.

## 1.2.2 Journey of Food from Harvest to Consumer

The following chart shows the journey food material goes through to become a final, consumable product to various customers.

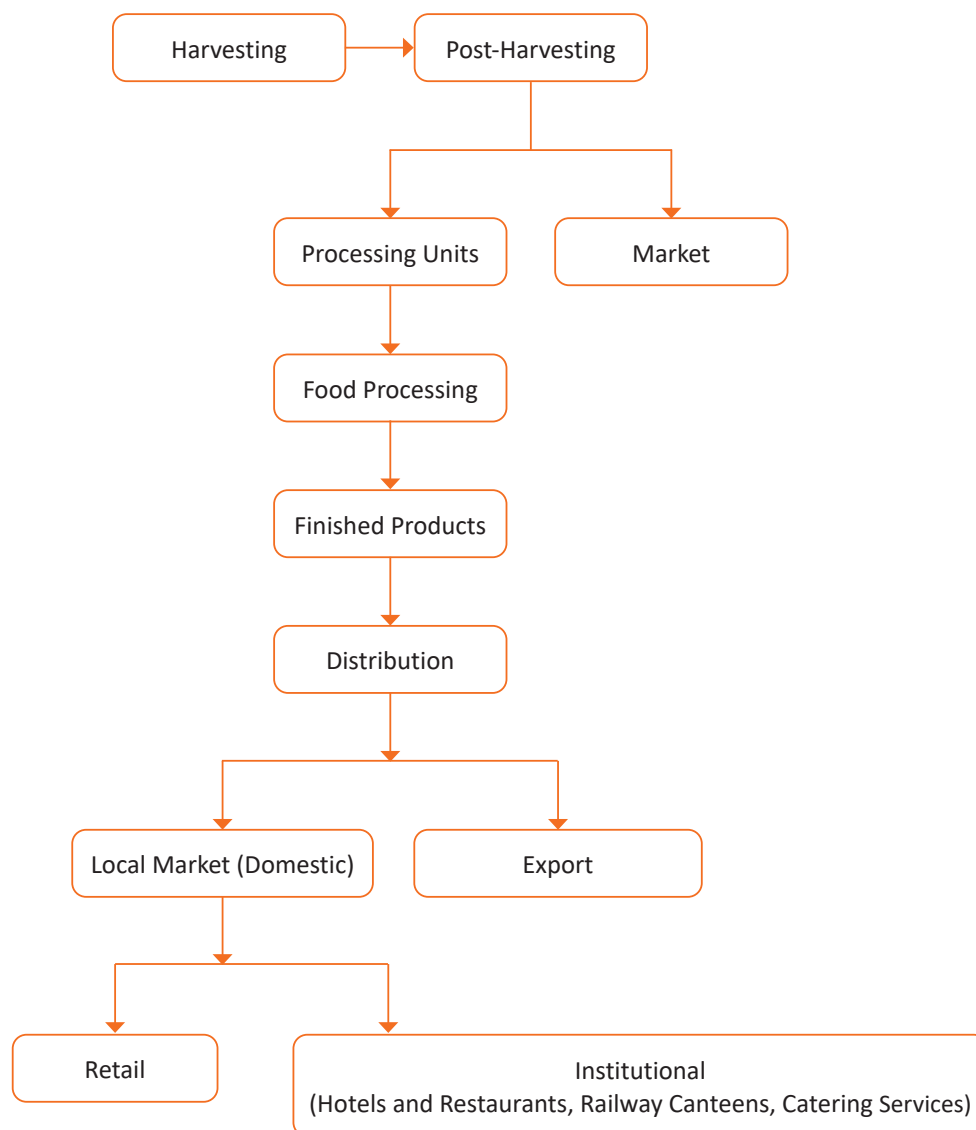


Fig. 1.2.2. Journey of harvested food

## UNIT 1.3: Packaging of Food Products and Cold Storage

### Unit Objectives

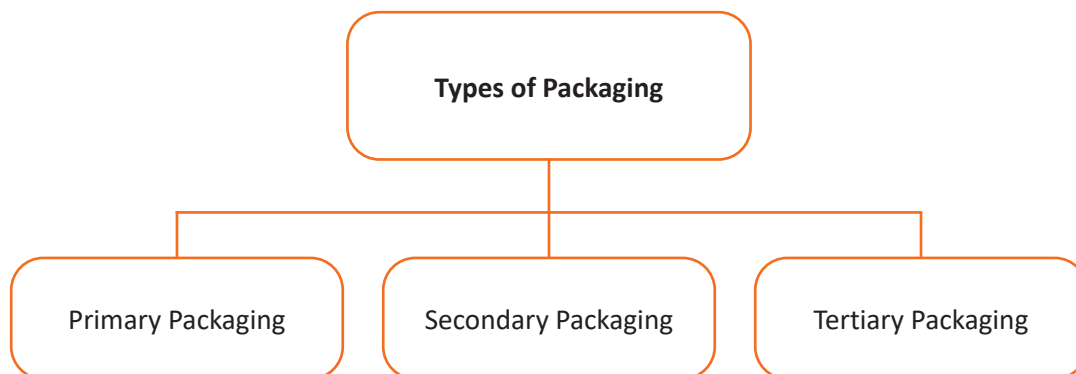
At the end of this unit, the trainee will be able to:

1. State the types and categories of packaging of food products
2. List the different products preserved in modified temperature
3. State the use of cold storage for food products.

### 1.3.1 Packaging of Food Products

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale and use. Packaging is the activity of designing and producing the container of the product.

Types of Packaging



1. **Primary Packaging:** The material that first envelops the product and holds it. This usually is the smallest unit of distribution or use and is the package which is in direct contact with the contents.
2. **Secondary Packaging:** Secondary packaging is outside the primary packaging, perhaps used to group primary packages together.
3. **Tertiary packaging:** Tertiary packaging is used for bulk handling, warehouse storage and transport shipping.

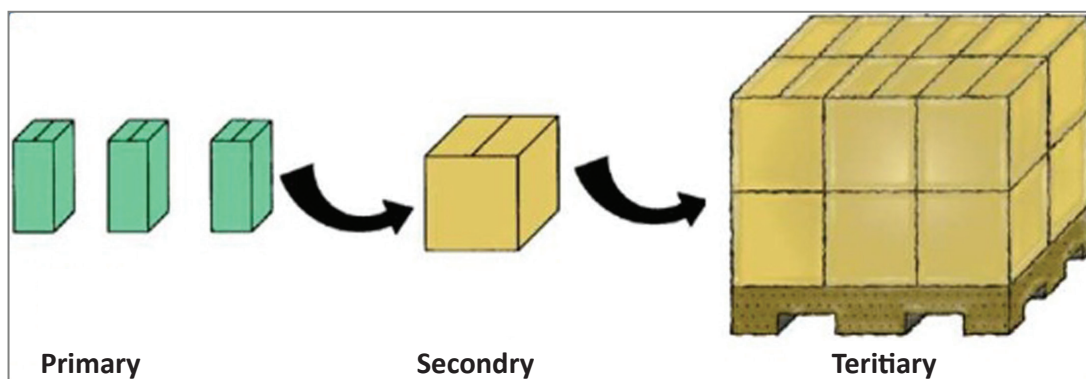


Fig. 1.3.1. Types of packaging

Various types of package materials are used for various products depending on the perishability of food.

Packaging of Milk Products	Packaging of Fruit and Vegetable Products
<ul style="list-style-type: none"> <li>• Glass bottles</li> <li>• LDPE lined cartons/aseptic cartons</li> <li>• Sanitary cans</li> <li>• Polypapers or poly-laminated paper packs in tetrahedron, pyramid or other forms</li> <li>• Open top sterilised sanitary cans or polystyrene tubs</li> <li>• Hermetically sealed tinplate containers</li> </ul>	<ul style="list-style-type: none"> <li>• Gunny bags</li> <li>• Wooden/plastic crates, in lined, or unlined corrugated fiberboard boxes</li> <li>• Net bags</li> <li>• Bamboo baskets or palm leaf baskets</li> <li>• Wooden boxes or lined or unlined corrugated fiberboard boxes</li> </ul>
Packaging of Meat, Fish and Poultry Products	Packaging of Bakery and Confectionary Products
<ul style="list-style-type: none"> <li>• Polyethylene sheets or bags</li> <li>• Butter paper or any grease proof clean wrapping material.</li> <li>• Tinplate containers or flexible packaging materials like egg powder</li> <li>• PET/LDPE laminate</li> <li>• Polyethylene lined insulated containers, made of plywood, country wood or plastic</li> <li>• Hermetically sealed tinplate containers</li> </ul>	<ul style="list-style-type: none"> <li>• LDPE coated poster paper</li> <li>• Clean waxed paper, grease –proof paper or any other suitable non-toxic wrapper</li> <li>• Containers made of tinplate, cardboard paper or other suitable material such as cello/LDPE, contact with the metal walls</li> </ul>

Table 1.3.1: Types of packaging material depending on Sub- sectors

## 1.3.2 Product Knowledge

### Food Products in Cold Storage

Foods and many other commodities can be preserved by storage at low temperature, which retards the activities of micro organisms. Micro organisms are the spoilage agents and consist of bacteria, yeasts and moulds. Low temperature does not destroy those spoilage agents but high temperature does. However, low temperature greatly reduces their activities, providing a practical way of preserving perishable foods in their natural state which otherwise is not possible through heating. The low temperature necessary for preservation depends on the storage time required, often referred to as short or long term storage and the type of product.

**In general, there are three groups of products:**

1. Foods that are alive at the time of storage, distribution and sale e.g. fruits and vegetables
2. Foods that are no longer alive and have been processed in some form e.g. meat and fish products
3. Commodities that benefit from storage at controlled temperature e.g. beer, tobacco, khandhari, etc

**Living foods** such as fruits and vegetables have some natural protection against the activities of micro organism. The best method of preserving these items is to keep the product alive and at the same time retard the natural enzyme activity which will retard the rate of ripening or maturity.

Preservation of **non-living foods** is more difficult since they are susceptible to spoilage. The problem is to preserve dead tissues from decay and putrefaction. Long term storage of meat and fish product can only be achieved by freezing and then by storing it at temperatures below -150C. Only certain fruits and vegetables can benefit from freezing.



## UNIT 1.4: Attributes of a Cold Storage Technician

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the roles and responsibilities of a Cold Storage Technician

### 1.4.1 Role and Responsibilities

#### Roles and Responsibilities

A Cold Storage Technician carries out various processes like:

- receiving the produce;
- assessing the quality;
- pre-cooling;
- creating ambient temperature, pressure, relative humidity;
- controlling atmosphere in the storage unit for storage of various produce;
- loading and unloading storage unit;
- monitoring and maintaining storage parameters for various types of produce;
- maintaining cleanliness, hygiene and safety of the storage unit for achieving quality and quantity products.

#### Skills Set

A Cold Storage Technician must have the ability to

- plan
- prioritise
- handle pressure
- organise
- calculate

As a Cold storage technician you must possess reading, writing and communication skills. In addition, you must have personal and professional hygiene and an understanding of food safety and hygiene in the work environment.

## Exercise

### 1. Fill in the blanks with the correct option.

- a. The journey of food from harvest ultimately reaches the \_\_\_\_\_ .
- |               |             |
|---------------|-------------|
| i. Consumers  | ii. Bankers |
| iii. Builders | iv. Bakers  |
- b. \_\_\_\_\_ is the activity of designing and producing the container of the product.
- |              |                  |
|--------------|------------------|
| i. Cleaning  | ii. Packaging    |
| iii. Dusting | iv. Transporting |
- c. \_\_\_\_\_ packaging is used for bulk handling, warehouse storage and transport shipping.
- |                |                |
|----------------|----------------|
| i. Primary     | ii. Tertiary   |
| iii. Secondary | iv. Elementary |
- d. A Cold storage technician should monitor and maintain \_\_\_\_\_ parameters for various types of produce.
- |                |              |
|----------------|--------------|
| i. temperature | ii. pressure |
| iii. humidity  | iv. storage  |
- e. A Cold storage technician must follow the \_\_\_\_\_ of the manufacturing unit.
- |                   |                  |
|-------------------|------------------|
| i. process flow   | ii. process gain |
| iii. process cost | iv. process role |
- f. Foods that are alive at the time of storage, distribution and sale are \_\_\_\_\_ .
- |                            |                                    |
|----------------------------|------------------------------------|
| i. meat and fish products  | ii. beer, tobacco, khandsari, etc. |
| iii. fruits and vegetables | iv. None of these.                 |
- g. Long term storage of meat and fish product can only be achieved by freezing and then by storing it at temperature below \_\_\_\_\_ .
- |           |           |
|-----------|-----------|
| i. -15°C  | ii. -10°C |
| iii. 15°C | iv. 10°C. |
- h. Packaging is an \_\_\_\_\_ .
- |                      |             |
|----------------------|-------------|
| i. art               | ii. science |
| iii. art and science | iv. math    |

## Notes



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Scan the QR codes or click on the link to watch the related videos



<https://www.youtube.com/watch?v=J-2EiMVNtpM>

Overview of food processing industry



<https://www.youtube.com/watch?v=Rkym0HNt9xE>

Roles and Responsibilities



<https://www.youtube.com/watch?v=Z11u2C-yhIY>

Orientation video



## 2. Food Safety, Hygiene and Sanitation



Unit 2.1 - Sanitation and Hygiene

Unit 2.2 - Safety Practices

Unit 2.3 - Good Manufacturing Practices (GMP)

Unit 2.4 - Hazard Analysis and Critical Control Point (HACCP)

Unit 2.5 - Storage Norms and Stock Rotation



## Key Learning Outcomes



**At the end of this unit, the trainee will be able to:**

1. State the personal hygiene and sanitation guidelines
2. List the different sanitisers used in the process area and equipment
3. Follow health and safety practices in the work area
4. State the importance of safety, hygiene, and sanitation in the food processing industry
5. Follow the industry standards to maintain a safe and hygienic workplace
6. State the storage and stock rotation norms
7. Follow HACCP principles to eliminate food safety hazards in the process and products

## UNIT 2.1: Sanitation and Hygiene

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. State the personal hygiene and sanitation guidelines
2. State the food safety hygiene standards to follow in a work environment
3. List the different sanitisers used in the process area and equipment.

### 2.1.1 Personal Sanitation

Sanitation and hygiene are the most important aspects to take care of when working in a food processing area. Some important sanitation and hygiene practices that must be followed are:

Maintain a high standard of personal cleanliness viz. have a bath every day and wear clean clothes to work.

Wear Personal Protective Equipment (PPE) such as aprons, mouth mask, head cover, face mask, hand gloves, gum boots, and beard cover mask at all times during work hours.

Always keep your finger nails trimmed.

Always keep your hair trimmed and wear a hair net while working.



Fig. 2.1.1. Personal sanitation



Fig. 2.1.2. Washing hands with soap and water

Wash your hands and feet at the designated area or wash stations provided.

Wash your hands with soap and water each time before you enter the production area.

Refrain from smoking, spitting, chewing paan, sneezing or coughing over any food when in the production area.

Do not handle food when suffering from a disease, illness, burns, injury or infection.

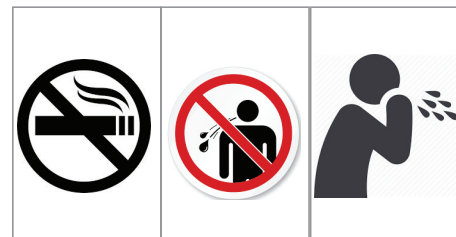


Fig. 2.1.3. Do not smoke, spit, cough



Fig. 2.1.4. Timely medical treatment

Take proper and timely medical treatment when you are ill or if you have met with an accident.

Visit a registered medical practitioner at regular intervals to keep a check on your health.

## UNIT 2.2: Safety Practices

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. Follow health and safety practices in the work area

### 2.2.1 Symbols

There are some symbols that you must know and understand to ensure safety in case of an emergency or fire. They are:



Caution



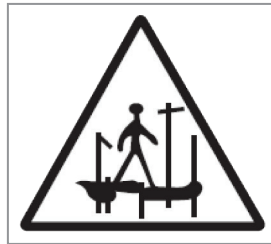
Danger Fragile Roof



Dangerous Chemicals



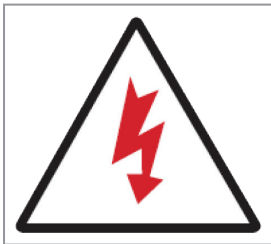
Do Not Enter



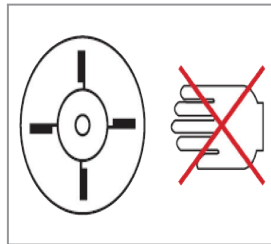
Danger Scaffolding Incomplete



Beware of Electric Shock



Electric Hazard



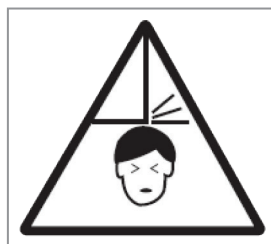
Never Put your Hand Inside during the Operation



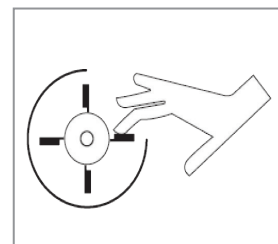
Highly Flammable



Hot Surface Do Not Touch



Mind Your Head

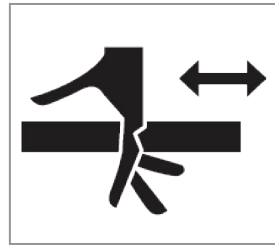


Never Open the Cover during the Operation

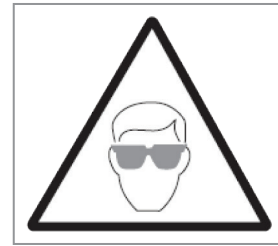




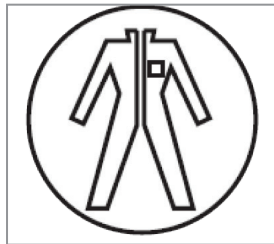
Use the Dust Bin



Never Touch Moving Part



Wear Eye Protection



Wear Protective Clothing



Warning Slippery Floor



This is a Tobacco Free Workplace



Assembly Point



Fire Exit

Fig. 2.2.1. Safety symbols

## 2.2.2 Emergency Measures

During an emergency, you must follow certain measures to tackle the situation in an organised manner.

- Do not panic
- Respond to your senior immediately or inform the matter to the concerned person
- Prepare against the emergency situation by keeping a fire bucket and a water source handy
- Evacuate the work area

After the emergency, you must:

- Report the situation to a senior or the concerned authority
- Undertake recovery measures

Fire Safety Measures

Just like emergency measures, some common fire safety measures must be followed in case of a fire. They are:

- Press the closest fire alarm button (if available)
- Call the fire brigade
- Assemble at the assembly point or designated area for safety
- Evacuate the building from the closest fire exit

### Types of Fire and Fire Extinguishers

Choosing the right extinguisher can prevent property damage and save lives				
Types of Fire Extinguishers →	Water	Foam	CO <sub>2</sub>	Dry Chemical
Types of Fire ↓				
<b>A</b> Class A: Paper, Wood, Plastic Fabric, Rubber, Trash	✓	✓	✗	✓
<b>B</b> Class B: Oil, Petrol, Some Paints and Solvents	✗	✓	✓	✓
<b>C</b> Class C: Electrical Equipment, Appliances, Computers	✗	✗	✓	✓

Fig. 2.2.2. Types of fire and fire extinguishers

### How to use the Fire Extinguisher?

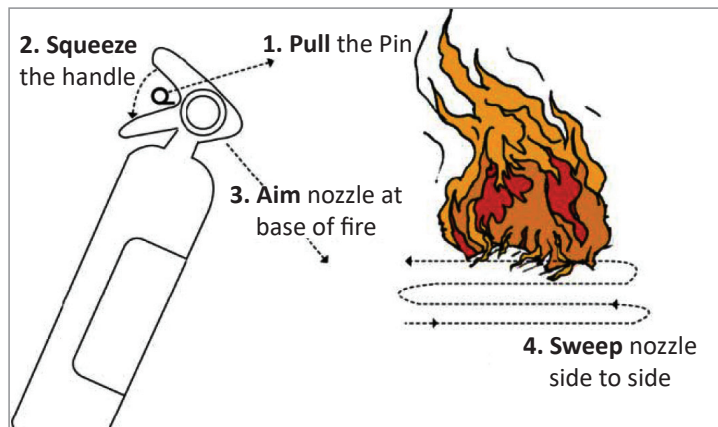


Fig. 2.2.3. Fire extinguisher

### How to use the Fire Buckets?

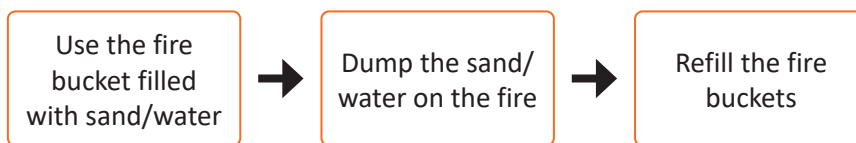


Fig. 2.2.4. Fire bucket

## UNIT 2.3: Good Manufacturing Practices (GMP)

### Unit Objectives

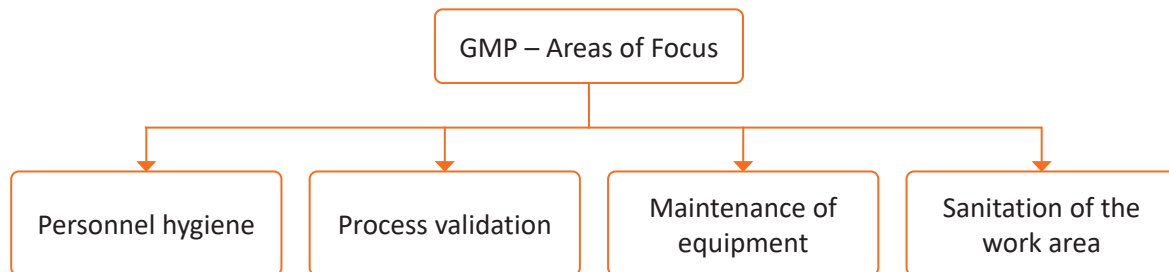


At the end of this unit, the trainee will be able to:

1. State the importance of safety, hygiene, and sanitation in the food processing industry
2. Follow the industry standards to maintain a safe and hygienic workplace
3. State the storage and stock rotation norms.

### 2.3.1 Good Manufacturing Practices (GMP)

GMP is a set of guidelines proposed by the Food Safety Standards Authority of India (FSSAI) to ensure the production of high quality and safe processed foods. It requires a qualitative approach towards manufacturing to reduce chances of microbial contamination, spoilage, and errors.



Area of focus	GMP
<p style="text-align: center;">Personnel hygiene</p> <div style="display: flex; justify-content: space-around;">   </div> <p><i>Fig. 2.3.1. Personnel hygiene</i>      <i>Fig. 2.3.2. Facilities for toilets</i></p>	<ul style="list-style-type: none"> <li>• Your organisation follows strict hygiene and sanitation guidelines</li> <li>• You are provided training on Good Manufacturing Practices (GMP)</li> <li>• You are in a sound health condition during working hours</li> <li>• You follow high standards of cleanliness</li> <li>• Your processing unit has enough facilities for toilets and wash stations</li> </ul>
<p style="text-align: center;">Sanitation of the work area</p> <div style="display: flex; justify-content: space-around;">   </div> <p><i>Fig. 2.3.3. Designated area for keeping utensils</i>      <i>Fig. 2.3.4. Sanitation of the work area</i></p>	<ul style="list-style-type: none"> <li>• The processing unit where you work is located in a clean, pollution-free area</li> <li>• The entire processing unit is well ventilated and has adequate lighting</li> <li>• The entire work area follows high standards of cleaning and sanitisation</li> <li>• There is a designated area for keeping utensils and equipment. It is kept clean and pest-free at all times</li> </ul>

## Equipment maintenance



Fig. 2.3.5. Equipment maintenance



Fig. 2.3.6. Monthly schedule

- The equipment used for processing foods is protected against contamination from lubricants, metal fragments, fuel, and contaminated water
- The cleaning and maintenance of tools, materials, and equipment is an easy process
- The organisation follows a cleaning and sanitising drill as per daily, weekly, and monthly schedules

## Process validation

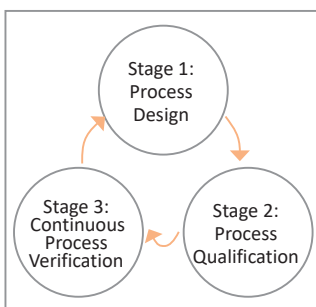


Fig. 2.3.7. Process validation



Fig. 2.3.8. Quality checks

- All processes of production, like raw material procurement, execution, storage, packaging, and logistics follow strict organisational parameters
- Quality checks are conducted at each step of production. This helps to ensure that food quality is maintained as per prescribed norms and standards
- The stock rotation of finished product follows the FEFO and FIFO methods. This is to ensure that there is a minimum chance of food spoilage. It will also help to retain the taste of processed foods

## UNIT 2.4: Hazard Analysis and Critical Control Point (HACCP)

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. Follow HACCP principles to eliminate food safety hazards in the process and products.

### 2.4.1 What is HACCP?

Hazard Analysis and Critical Control Point (HACCP) is an international food safety regulation that is followed to reduce the risk of hazards in a food processing unit. It is a system that identifies possible hazards and controls them at various points of the production process. The HACCP is based on seven principles. They are:

#### Conduct a hazard analysis

- Evaluate the production process and identify the points where hazards (physical, chemical, and biological) may be introduced

#### Identify critical control points

- Identify the critical points in the process plan where a hazard may occur
- Plan preventive measures at that critical point to control the risk

#### Establish critical limits

- State the boundary line between safe and unsafe processes
- State the limit until which a critical point maybe controlled

#### Establish a monitoring system

- State the process of monitoring critical points and critical limits

#### Establish corrective measures

- Specify the corrective actions that should be followed when critical limits are crossed

#### State verification procedures

- State the verification process to check whether HACCP principles are applied and followed
- Test the HACCP plan and ensure compliance on a regular basis
- Check whether the HACCP plan helps to prevent hazards effectively

#### Follow record-keeping procedures

- Keep records of all the critical points
- Maintain a log of situations when critical limits were exceeded
- State the corrective measures that were applied
- Include records of the development and maintenance of the system

## Example of an HACCP Plan

Operational step	Hazard	Control measure	Critical limit	Monitoring method	Corrective action	Responsibility	Record
Procurement of raw material	Physical (dirt, stone particles)	Supplier guarantee specifications established by quality assurance department	As per company internal specifications	Supplier guarantee certificate is visually confirmed	Reject materials if not accompanied by supplier guarantee	Store manager	Supplier guarantee
	Chemical (toxins, pesticides from raw material)	Relative humidity of the store to be maintained					
	Microbiological (high microbiological load of raw materials, presence of pathogenic bacteria)	FIFO system should be established		Monitor temperature and humidity of storage			Store temperature logs

Table 2.4.1: Example of an HACCP Plan

## UNIT 2.5: Storage Norms and Stock Rotation

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the storage norms for safe storage of food in a MA storage
2. State the different stock rotation methods used in food processing industry.

### 2.5.1 Food Storage

When storing food, store the food in such a way that:

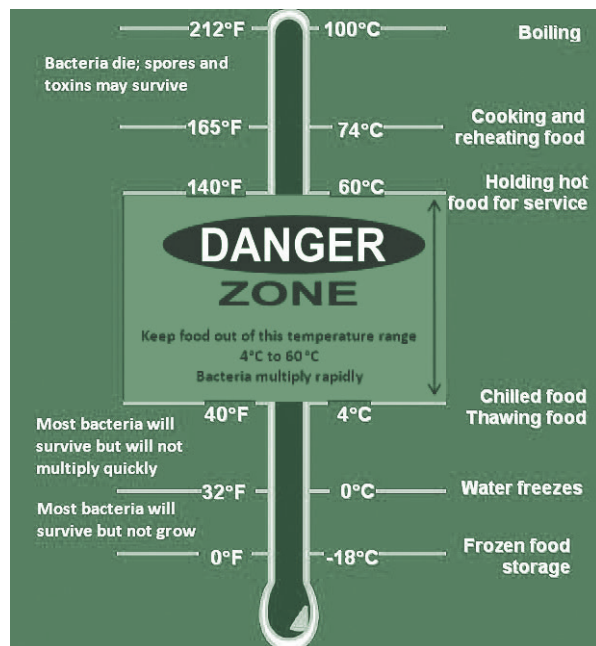
- It is protected from the likelihood of contamination; and
- The environmental conditions under which it is stored will not adversely affect the safety and suitability of the food.

When storing potentially hazardous food:

- Store it under temperature control; and
- If it is food that is intended to be stored frozen, ensure the food remains frozen during storage.



Fig. 2.5.1. Ensure hygienic food storage



### 2.5.2 Meaning of Stock Rotation

To rotate stock means to arrange the oldest units in inventory or storage so it gets consumed before the newer units. The reason to rotate stock is to reduce the losses from deterioration and obsolescence.

### 2.5.3 What is FIFO?

FIFO (First-IN, First-OUT) is a basic rule of product rotation that protects product quality and freshness. Rotate foods so the first products displayed (IN) are the first products sold (OUT) to minimize spoilage and waste. Every product has a code date. Do NOT use products past their code or “use-by” dates.

FIFO stock rotation in storage areas

- Find the product’s code date and remove out-of-code items.
- Move previously received merchandise forward and/or to the top of the stack.
- Put new items at the back of the row and/or on the bottom of the stack.
- Always position products on the shelf/tray so the oldest products will be used first.

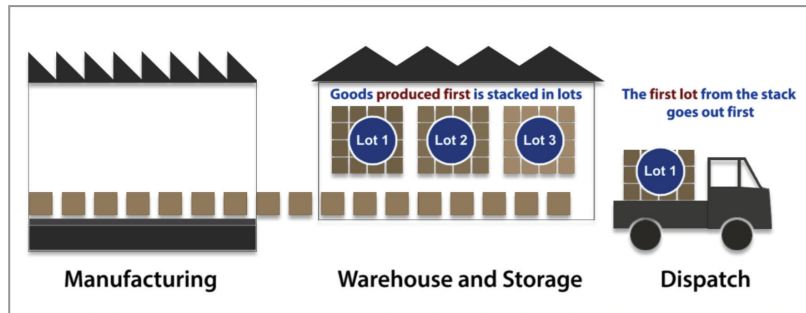


Fig. 2.5.2. FIFO stock rotation

## 2.5.4 What is FEFO?

FEFO is an acronym of the words First Expired, First Out. Material requirements are serviced in the order of items with the earlier date of consumption regardless of the date of entry or acquisition.



Fig. 2.5.3. FEFO stock rotation



**Exercise****1. Tick with the correct option.**

- a. For fire safety:
- i. Call the fire brigade
  - ii. Assemble at the assembly point or designated area for safety
  - iii. Evacuate the building from the closest fire exit
  - iv. All of above
- b. Separate storage area should be located near:
- i. Coldest part of the basement
  - ii. Hottest part of the basement
  - iii. A and B
  - iv. All of above
- c. The stock rotation of finished product follows the FEFO and FIFO methods, which are part of
- i. Equipment Maintenance
  - ii. Process Validation
  - iii. Personal hygiene
  - iv. Sanitation of work area
- d. These foods spoil only if stored improperly.
- i. Perishable
  - ii. Non-perishable
  - iii. Semi-perishable
  - iv. Junk
- e. Food preservation helps to delay:
- i. Production
  - ii. Execution
  - iii. Processing
  - iv. Spoilage

## 2. Match the columns

Hazard Analysis		HACCP Principle	
a.	Plan preventive measures at that critical point to control the risk	i.	Follow record-keeping procedures
b.	State the boundary line between safe and unsafe processes	ii.	State verification procedures
c.	Specify the corrective actions that should be followed when critical limits are crossed	iii.	Establish critical limits
d.	Test the HACCP plan and ensure compliance on a regular basis	iv.	Establish a monitoring system
e.	Maintain a log of situations when critical limits were exceeded	v.	Conduct a hazard analysis
f.	Evaluate the production process and identify the points where hazards may be introduced	vi.	Identify critical control points
g.	State the process of monitoring critical points and critical limits	vii.	Establish corrective measures

Notes



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Introduction to food safety



<https://www.youtube.com/watch?v=RS4A-uczS6E&t=552s>

Introduction to GMP,GHP & FSMS



# 3. Prepare and Maintain Work Area and Refrigeration Equipments



Unit 3.1 - Equipment used in Refrigeration Process

Unit 3.2 - Sanitisation of the Work Area

Unit 3.3 - Cleaning Processes

Unit 3.4 - Usage and Maintenance of Equipment and Machineries



## Key Learning Outcomes



**At the end of this unit, the trainee will be able to:**

1. Identify the different equipment used in the refrigeration process
2. State the materials and equipment used in cleaning and maintenance of the work area and machineries
3. List the various cleaning chemicals required
4. State the cleaning processes used to clean the work area and process machineries
5. Dispose waste as per organisation standards and industry requirements.

## UNIT 3.1: Equipment used in Refrigeration Process

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. Identify the different equipment used in the refrigeration process.

### 3.1.1 Equipment Used in the Refrigeration Process

Types of equipment used in refrigeration process are:

1. Compressors
2. Condensers
3. Evaporators
4. Expansion Devices



Fig. 3.1.1. Compressors



Fig. 3.1.2. Evaporators

#### 1. Compressors:-

Types of Compressor



Fig. 3.1.3. Reciprocating compressor

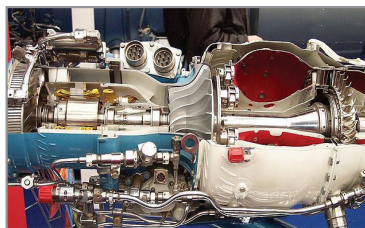


Fig. 3.1.4. Centrifugal compressor



Fig. 3.1.5 Rotary compressor



Fig. 3.1.6. Screw compressor



Fig. 3.1.7. Scroll compressor

- The reciprocating and screw compressors are best suited for use with refrigerants which require a relatively small displacement and condense at relatively high pressure, such as R-12, R-22, Ammonia, etc.
- The centrifugal compressors are suitable for handling refrigerants that require large displacement and operate at low condensing pressure, such as R-11, R-113, etc.

- The rotary compressor is most suited for pumping refrigerants having moderate or low condensing pressures, such as R-21 and R-114; this is mainly used in domestic refrigerators.
- Rotary compressors are positive displacement, direct-drive machines. There are essentially two designs of this compressor:
  - Rolling piston type
  - Rotating vane type

## 2. Condensers

The functions of the condenser is to desuperheat the high pressure gas, condense it and also sub-cool the liquid.

Types of Condenser

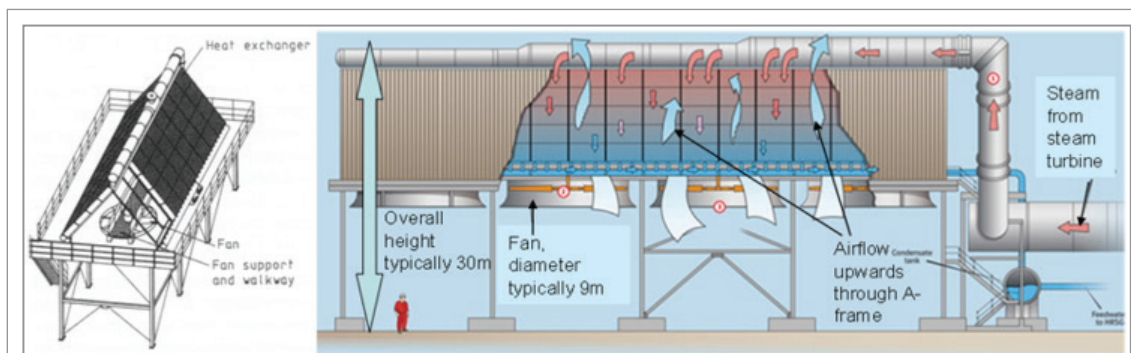


Fig. 3.1.8. Air-cooled condenser



Fig. 3.1.9. Water-cooled condenser

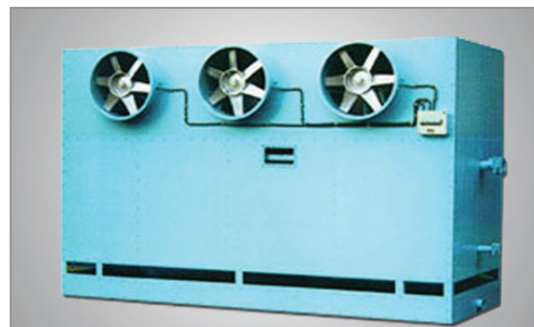


Fig. 3.1.10. Evaporative condenser

## 3. Evaporators

- The process of heat removal from the substance to be cooled or refrigerated is done in the evaporator.
- The liquid refrigerant is vaporized inside the evaporator (coil or shell) in order to remove heat from a fluid such as air, water etc.
- Evaporators are manufactured in different shapes, types and designs to suit a diverse nature of cooling requirements.
- Types of evaporators include prime surface types, finned tube or extended surface type, shell and tube liquid chillers, etc.



Types of evaporators are classified into two general categories:

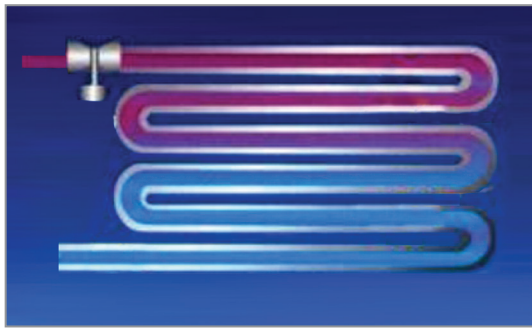


Fig. 3.1.11. Dry expansion evaporator

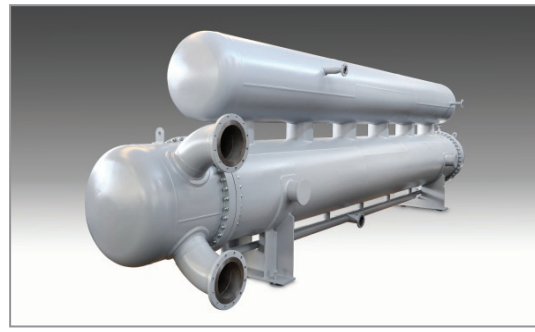


Fig. 3.1.12. Flooded evaporator

#### 4. Expansion devices

The different types of expansion or throttling devices are:

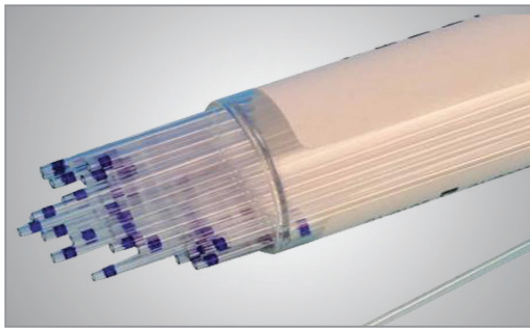


Fig. 3.1.13. Capillary tube

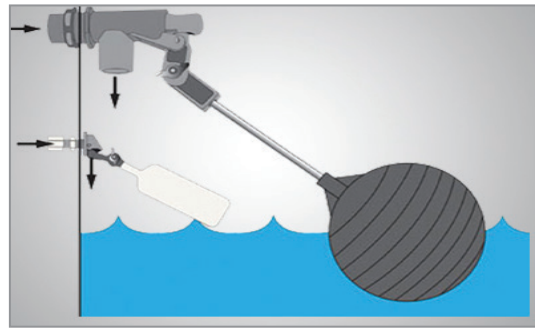


Fig. 3.1.14. Float valves



Fig. 3.1.15. Thermostatic expansion valve

## UNIT 3.2: Sanitisation of the Work Area

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. State the materials and equipment used in cleaning and maintenance of the work area and machineries
2. List the various cleaning chemicals required.

### 3.2.1 Cleaning and Sanitisation

Cleaning and sanitisation of the work area is extremely important for every food-handling operation. Hence, it is important to know:

- What types of materials and equipment must be used to clean the work area?
- How to use these materials and equipment?
- The method of cleaning the work area
- The frequency of cleaning the process machineries

The food processing industry follows standard procedures for cleaning the work area. This is to ensure that there is no bacterial growth due to presence of leftover food particles. For cleaning purposes, the work area is divided into two. They are:

Food contact surfaces	Non-food contact surfaces
Work tables	Overhead structures
Utensils	Walls, ceilings, and shields
Equipment	Lighting equipment
Tools like knives	Refrigeration equipment
Machines that process foods	Air conditioning, heating or ventilating systems

Table 3.2.1: Different types of cleaning surfaces

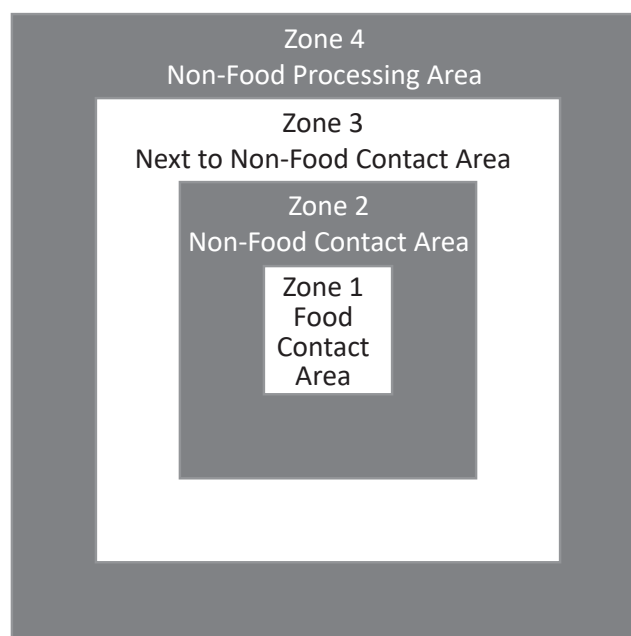


Fig. 3.2.1. Food contact and non-contact zones in a production area

### Equipment, Chemicals, and Sanitisers Used for Cleaning

Every organisation in the food processing industry follows a cleaning schedule. For instance, a processing unit may follow a weekly, monthly or yearly cleaning schedule. To clean the processing unit, the following equipment and tools are used:

- Cleaning or washing tank
- Cleaning knives and spoons
- Cleaning or sanitising agents
- Cleaning brushes and scrubbers
- High spray nozzle jets



Fig. 3.2.2. Cleaning knives and spoons



Fig. 3.2.3. Cleaning agents and equipments



Fig. 3.2.4. Cleaning in washing tanks



Fig. 3.2.5. Cleaning floors of production area



Fig. 3.2.6. Cleaning equipment parts

Some common types of cleaners and sanitising agents to clean the food contact and non-food contact surfaces are:

Cleaning agents	Used for	Risk	Safety measure
Hypochlorites like potassium hypochlorite, sodium hypochlorite, and calcium hypochlorite	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
Hydrogen peroxide	Killing bacterial spores, pathogens, spoilage organisms, and other microorganisms	Has a strong odour	Use in well-ventilated and open spaces
Ozone	Cleaning food-contact and non-food-contact surfaces like equipment, walls, floors, drains, conveyors, tanks, and other containers; Killing microbes	No risk involved since it leaves no residue	Safe to use

Table 3.2.2: Types of cleaning agents

### Storage of Sanitisers and Disinfectants

Sanitisers and disinfectants are packed and labelled in a proper manner. They are kept in a safe area within the storeroom. The cleanliness of this area is maintained at all times.

## UNIT 3.3: Cleaning Processes

### Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the cleaning processes used to clean the work area and process machineries.

### 3.3.1 Clean-In-Place (CIP)

CIP is a method used for internal cleaning of machineries. It is done without dismantling pipes, vessels, process equipment, filters or fittings. In this process, a sanitising agent is circulated through the entire processing unit with the help of a spray ball. The turbulence created removes soil, ensuring removal of bacteria and chemical residues.

Tips to conduct an effective CIP process:

- Use the right vessels for the right process
- Use the right cleaning and sanitising solutions
- Ensure correct flow rate
- Ensure all connections are clean
- Monitor and verify the entire process

### 3.3.2 Clean-Out-Of-Place (COP)

COP is conducted at a cleaning station. This method involves dismantling of the equipment. In this process, equipment and units are scrubbed with soap in COP tanks. After this, the tanks are rinsed again to remove residual detergent or chemicals. Equipment and units are reassembled and sanitised once more with heat treatment or sanitising agent.

Tips to conduct an effective COP process:

- Follow the order of tasks
- Use cleaning tanks as much as possible
- Ensure tools used in COP do not lead to contamination

Food processing equipment and units that undergo the COP process are:

- Fittings
- Gaskets
- Valves
- Tank vents
- Grinders
- Pumps
- Knives
- Nozzles

### 3.3.3 Sterilising-In-Place (SIP)

SIP is the process by which food processing equipment is sanitised after the CIP process. It helps to eliminate any residual microbiological contamination.

SIP is a combination of three processes viz. sterilisation, disinfestation, and sanitisation.

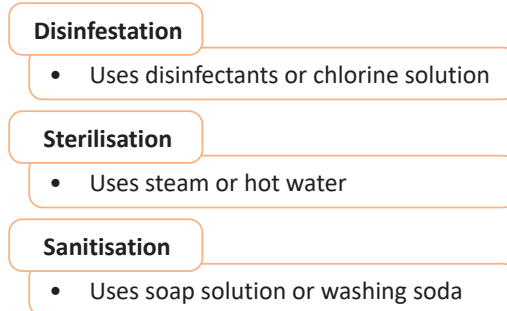


Fig. 3.3.1: Sterilising-In-Place (SIP)

### 3.3.4 Air-Pressure Cleaning

The food processing industry follows the air-pressure cleaning method to ensure cleanliness of regularly used equipment. The following chart explains the process in detail:



Fig. 3.3.2: Air-Pressure Cleaning

### 3.3.5 Process of Cleaning the Work Area

The following chart explains the process of cleaning the work area before production. The dotted boxes explain pest-control measures and methods used for waste material disposal in detail.

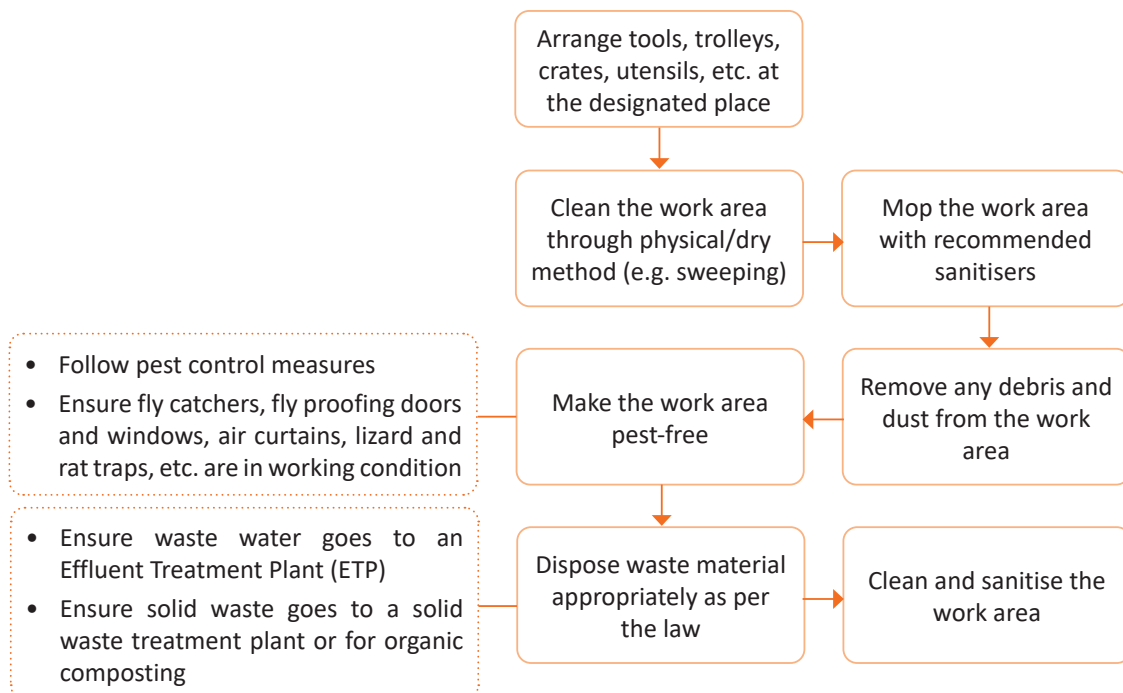


Fig. 3.3.3: Process of Cleaning the Work Area

### 3.3.6 Process of Cleaning Machineries, Tools and Equipment

The chart explains cleaning of machineries, tools, and equipment used in the food processing industry. The dotted chart states the techniques used for mechanical cleaning of equipment.

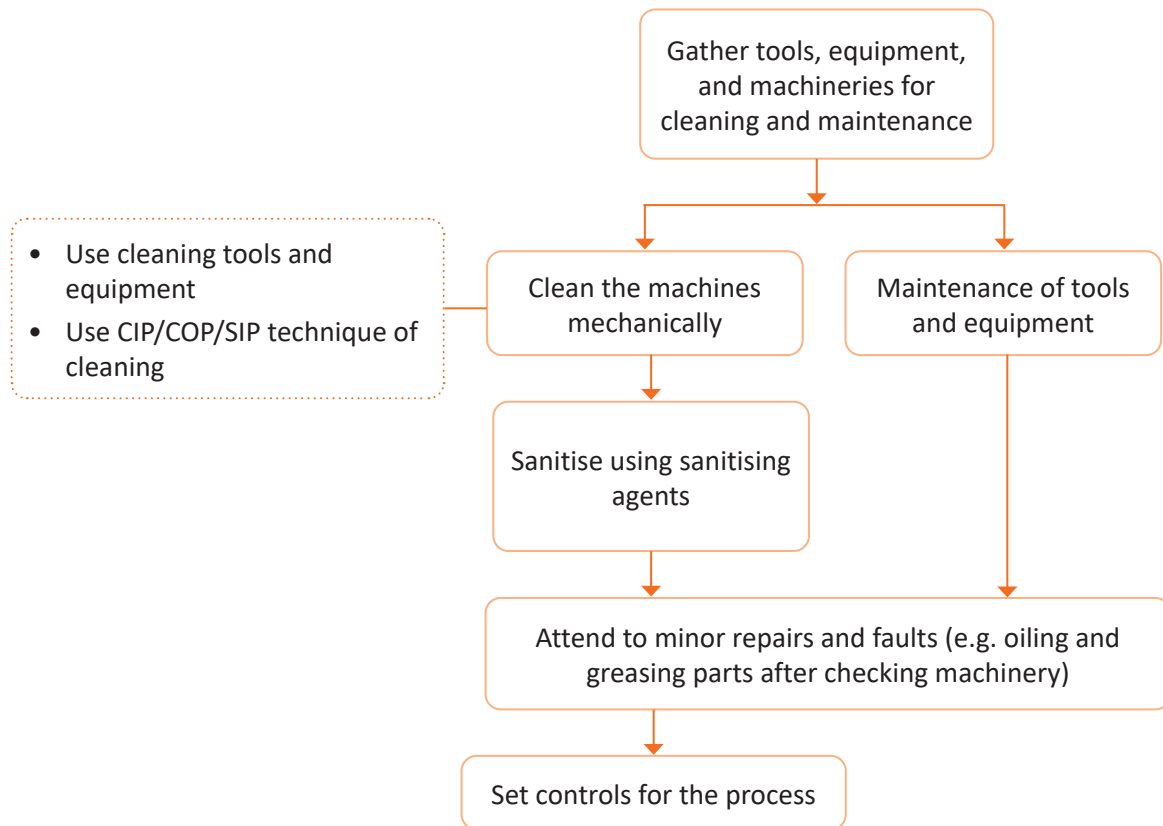


Fig. 3.3.4: Process of Cleaning Machineries, Tools and Equipment

## UNIT 3.4: Usage and Maintenance of Equipment and Machineries

### Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Explain the maintenance procedure to be followed for dairy processing machineries to be followed in Cold storages before starting production
2. State the different types of maintenance procedures

### 3.4.4 Types of Maintenance

#### Preventive Maintenance

In order to ensure smooth functioning of all equipment and machineries, the dairy industry follows a preventive maintenance schedule. This schedule includes four processes namely:

- Cleaning
- Inspection
- Oiling
- Retightening

#### Types of Maintenance

The maintenance procedures followed in the dairy industry are broken into four categories. The following table explains the differences:

Type of Maintenance	
Periodic maintenance	<ul style="list-style-type: none"> <li>• Involves periodically inspecting, servicing, and cleaning the equipment</li> <li>• Involves periodic replacing of parts to prevent sudden failure and process problems</li> </ul>
Predictive maintenance	<ul style="list-style-type: none"> <li>• Involves predicting the service life of important parts/equipment based on inspection or diagnosis</li> <li>• Parts/equipment are used only till their service life</li> </ul>
Corrective maintenance	<ul style="list-style-type: none"> <li>• Improves equipment and its components to ensure better preventive maintenance</li> <li>• Involves redesigning of equipment to improve reliability</li> </ul>
Breakdown maintenance	<ul style="list-style-type: none"> <li>• Involves repairing of equipment after breakdown</li> <li>• Conducted when the equipment failure does not significantly affect the operation and/or production or generate any significant loss other than repair cost</li> </ul>

*Table 3.4.2 Types of maintenance procedures followed in the dairy industry*



### 3.4.5 Maintenance and Check

In food manufacturing, maintenance supports various key objectives, many of which are unique to food production. Maintenance plays the following roles in food manufacturing:

1. It keeps the production running smoothly.
2. It helps to prevent any contamination and ensure food safety.
3. It reduces product losses.
4. It maintains regulatory compliance.

An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.

Following are the types of maintenance that are carried out in a food processing unit:

1. **Reactive Maintenance** is a method where machines run until they fail. It's a hands-off approach, and the significant benefit is that it keeps routine maintenance costs low.
2. **Predictive Maintenance** uses advanced technology such as infrared and ultrasound equipment during the routine inspection of machines. This process can stop unpredicted breakdowns, and using advanced technology and the industrial unit can reduce the amount of time needed to inspect equipment piece by piece. This type of maintenance is expensive, but this method accurately stays a step-in front of faults.
3. **Proactive Maintenance** is a systemic issue-focused maintenance program. Rather than examining equipment, this approach considers how to control the problems that lead to machine wear and tear instead of the deterioration itself.
4. **Preventative Maintenance** is the checking of machines and equipment on a planned, regular basis. The purpose is to prevent costly down-time and minimize the probability of faults. It requires more planning and effort than other techniques. However, it has long and short-term benefits in cost-reduction and efficiency of machine performance. Preventative checks are done before a machine breakdown and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production. This consists of:

- Time schedule stating when and how frequently maintenance should be done
- Maintenance activities list for each item

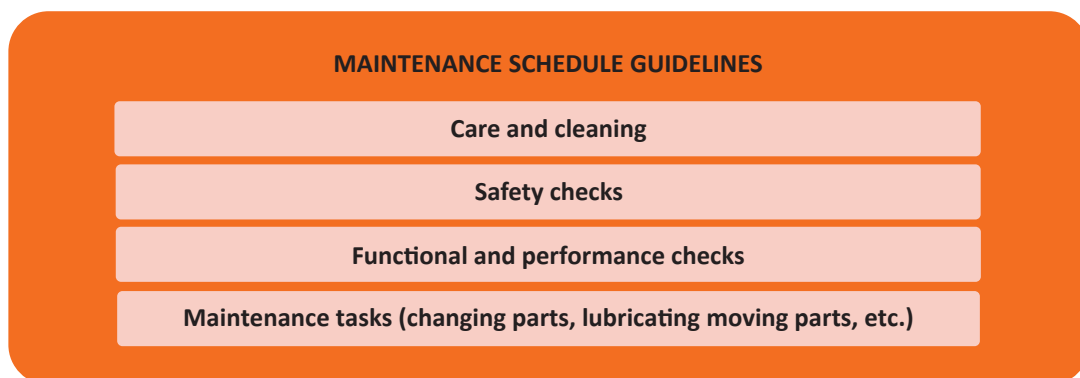


Fig. 3.4.11: Maintenance Schedule Guidelines

### Checklist for Planning Maintenance

- 
- 1 Identify the assets that require preventative maintenance.
  - 2 Distinguish what kind of safety checks the machine will need.
  - 3 Assess whether parts need replacing or cleaning.
  - 4 Decide how regularly assets need checking.
  - 5 Create a formal risk assessment process to help the person responsible for checks.
  - 6 Talk to employees who work closely with equipment to discover more about how the machines are operating at the time of the check.
  - 7 Find out if parts need cleaning, lubricating, or changing.

Fig. 3.4.12: Maintenance Checklist

After completing any maintenance, the technician must keep a log for maintenance. This log entry should include a description of the work carried out, who carried it out, and the date and time it happened.

**Document Maintenance Procedures.** Every piece of equipment and machinery should have detailed descriptions, drawings, and photographs of how and when each machinery should be maintained or serviced. It includes:

- Maintenance procedures
- Lubrication procedures
- Tool reconciliation procedures
- Procedures for temporary repairs
- Procedures for emergency repairs
- Spare parts inventory program
- Training procedures
- Handover procedures
- Audit Procedures

**Note:**

An annual maintenance contract (AMC) is an agreement between an organization and a service provider that specifies the ongoing maintenance of machinery or property purchased from the provider. Therefore, ensure periodic maintenance by AMC (Annual Maintenance Contract) personal.

## Exercise

### 1. Tick with the correct option.

- a. This cleaning process is done with dismantling of the equipment.
- i. CIP
  - ii. COP
  - iii. SIP
  - iv. None of the above
- b. This cleaning process is used for internal cleaning of machineries. It is done without dismantling pipes.
- i. CIP
  - ii. COP
  - iii. SIP
  - iv. sanitisation
- c. This cleaning process is used for cleaning fittings, gaskets and valves.
- i. CIP
  - ii. COP
  - iii. SIP
  - iv. SOP
- d. This cleaning agent is used to clean stainless steel food contact surfaces that can lead to corrosion if pH concentrations are not maintained
- i. Hydrogen peroxide
  - ii. Ozone
  - iii. Hypochlorite
  - iv. Liquid Chlorine

### 2. Arrange the right sequence of food spoilage.

Procedure/ Steps	Order the steps (as 1, 2, 3, 4, 5, 6 and 7)
a. Equipment is re-fitted	
b. High pressure air is blown towards ovens and conveyors	
c. Equipment is oiled and greased	
d. Equipment is removed and wiped	

**3. Match the columns**

Column A	Column B
a. Compressor	i. Float valves
b. Condenser	ii. Water-cooled
c. Evaporator	iii. Rotary compressor
d. Expansion Device	iv. Dry expansion evaporator

**4. Answer the following Questions:**

i. List the types of equipment used in refrigeration process:

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_

**5. Identify the food contact and non-food contact surfaces. Mark a tick against the correct option.**

a. Work tables	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
b. Overhead structures	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
c. Utensils	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
d. Air conditioner	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
e. Ventilating systems	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
f. Lighting equipment	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
g. Refrigeration equipment	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>

h. Walls and ceilings	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
i. Tools like knives	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>
j. Machines that process food	Food contact surface	<input type="checkbox"/>
	Non- food contact surface	<input type="checkbox"/>

## Notes



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Overview of controlled atmosphere storage



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Machine and equipments used in cold storage



## 4. Handle Cold Storage Facility for Storing Food



Unit 4.1 - Basic Principles of Refrigeration

Unit 4.2 - Installation of Refrigeration

Unit 4.3 - Basic Calculations

Unit 4.4 - Storage of Food in Cold Storage

Unit 4.5 - Methods to Monitor Food in Cold Storage

Unit 4.6 - Quality Assessment

Unit 4.7 - Repair and Maintenance



## Key Learning Outcomes



**At the end of this unit, the trainee will be able to:**

1. State the refrigeration principles, techniques and practices
2. Interpret drawings and diagrams of a cold storage system and facility
3. List the components of refrigeration system and their installation
4. List the type of refrigerants and the procedure to handle them
5. State the methods to calibrate the testing equipment
6. Calculate the load in a cold storage refrigerant
7. Identify the types of food that can be stored in cold storage
8. State the storage parameters for various type of food
9. State the methods to monitor and control the cold storage facility
10. State the procedure for charging refrigerant in the refrigeration system
11. State the process of quality assessment
12. Identify faults in a refrigeration system
13. State the procedure for repairing and maintenance of the refrigeration system.



## UNIT 4.1: Basic Principles of Refrigeration

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. State the refrigeration principles, techniques and practices
2. Interpret drawings and diagrams of a cold storage system and facility.

### 4.1.1 Basic Principles of Refrigeration

#### Basic Principles of Refrigeration

The vapour compression refrigeration cycle

1. Compression of a gas causes its temperature to increase. When the gas is cooled and sensible and latent heat removed, the temperature decreases and the gas condenses to liquid which is also the boiling point of the liquid. (The compression also increases the temperature at which the liquid boils). The liquid is then further cooled to around atmospheric temperature.
2. When the liquid is expanded (volume increased) into a lower pressure system, it will boil and cause the liquid temperature to decrease rapidly as it gives up sensible heat to provide the latent heat of partial vaporization of the liquid. The cold liquid and vapour, (the latent heat does not increase the vapour temperature), now pass through the coils inside the 'Cold Box' (or Evaporator) of the system.

Exchange of heat between the refrigerant and the material or space being cooled, adds more heat to the refrigerant liquid which continues to evaporate. The refrigerant, on leaving the cooling system is now all cool vapour and passes to the suction of the compressor to begin the cycle again. The sequence of the refrigeration cycle is as follows:

- Compression of the refrigerant gas.
- Cooling and condensation of the refrigerant to liquid.
- Expansion and partial evaporation of the liquid into a lower pressure which causes cooling.
- Continued evaporation of the liquid in the 'cold box' - further heating by removal of sensible heat from the item being cooled, to provide the latent heat of vaporization of the refrigerant.
- Re-compression of the vapour to begin the cycle again.

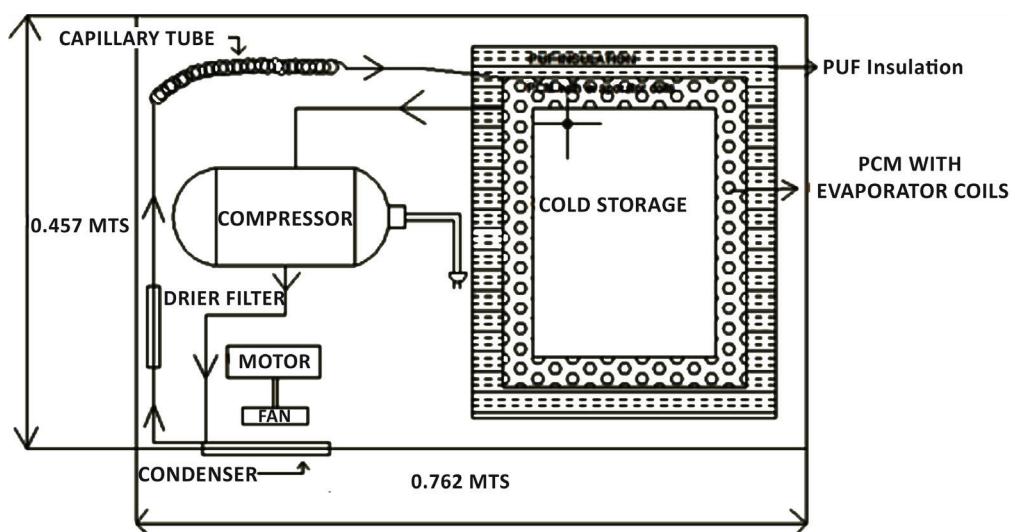


Fig. 4.1.1. Layout of cold storage model

## UNIT 4.2: Installation of Refrigeration

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. List the components of refrigeration system and their installation
2. List the type of refrigerants and the procedure to handle them
3. State the methods to calibrate the testing equipment.

### 4.2.1 Basic Components of a Refrigeration System

The five basic components of a refrigeration system are:

- Evaporator
- Compressor
- Condenser
- Expansion Valve
- Refrigerant; to conduct the heat from the product

In order for the refrigeration cycle to operate successfully, each component must be present within the refrigeration system.

### 4.2.2 Types of Refrigerants

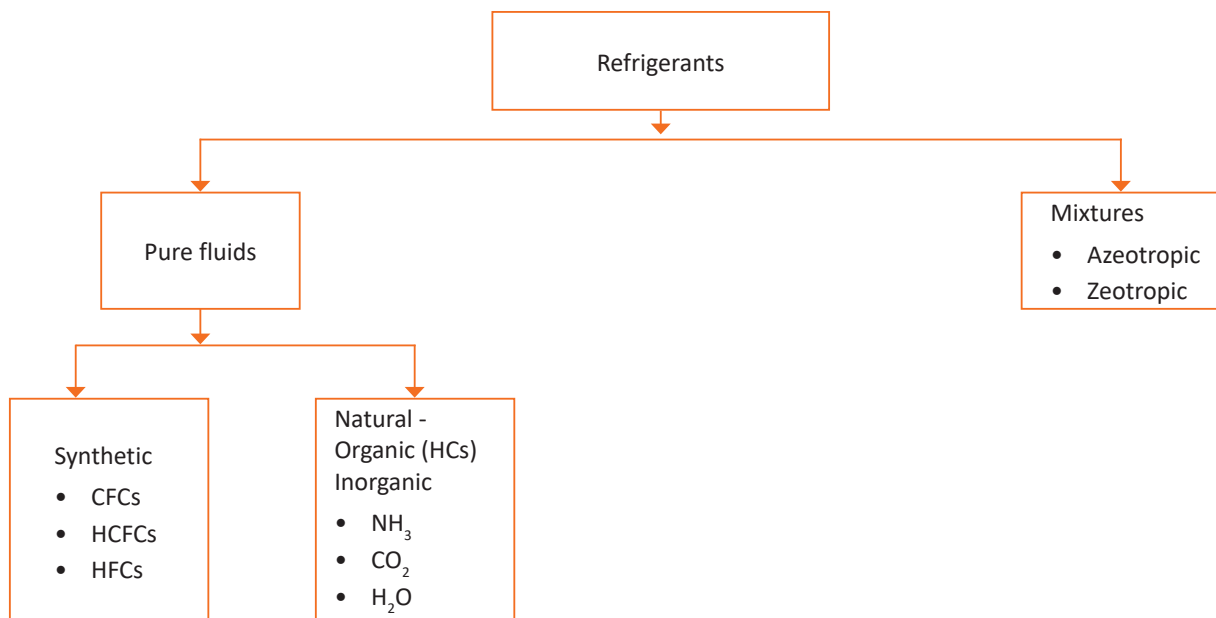


Fig. 4.2.1: Types of Refrigerants

Temperature calibration

- Calibrate each system to 0°C or to the system set point.
- During installation and commissioning of walk-in freezers calibrate the system to 0°C and then confirm at -22°C.

Procedure for Calibrating, Standardising Or Checking Equipment

**Example**

## Thermometers (General Purpose)

T 49, T 51, T 100, T 104, T 166, T 202, T 209, T 228, T 245, SD 102, SD 304, SD 310, SD 312, SD 313, SD 408

## Purpose

To provide instructions for standardising the accuracy of general purpose thermometers.

## Inspection Equipment Required:

1. Certified or calibrated thermometer
2. Oil or water bath

## Tolerance

Thermometers shall meet the temperature range requirements found in the appropriate test methods listed above.

## Procedure:

1. Obtain a thermometer that is certified or calibrated for the temperature ranges that will be used during standardisation procedure.
2. Place the certified or calibrated thermometer in the oil or water bath and adjust the bath to the temperature range of the thermometer to be tested.
3. After the temperature has stabilised, place the thermometer being tested next to the certified or calibrated thermometer.
4. Record the reading from the thermometer being tested and the temperature of bath.
5. If needed, adjust thermometer to correct temperature and retest. A correction factor may be applied to non adjustable thermometers up to  $\pm 5.00\text{F}$  or  $\pm 2.80\text{C}$

**4.5.2 Start up of Refrigeration System**

## Low Side Refrigerant Charging

- Low side charging is also referred to as vapor charging - that is ONLY refrigerant vapor or gas to enter the system is allowed
- This is an easy but time consuming method of system charging. The canister supplying refrigerant is connected to the gauge service port and opened, and the HVAC equipment or appliance is run (which pumps refrigerant gas from the supply source in parallel with pumping from the outlet of the evaporator coil)
- The refrigerant canister is kept upright so that only gas leaves the canister

## High Side Refrigerant Charging

- When charging an air conditioner, heat pump, or refrigeration appliance from the high side, the system being serviced is turned OFF. The refrigerant gas canister is placed upside down so that only pure liquid refrigerant leaves the canister
- Note that once you start the system running you will not be able to charge on the high side because the head pressure out of the compressor will be higher than the evaporation pressure in the canister - it would push refrigerant back into the canister

## Practical



### Objective

1. Execute the installation process of all the components of refrigeration system

### Materials required for the practical:

- Evaporator
- Compressor
- Condenser
- Expansion valve
- Refrigerant
- Calibrated thermometer
- Tools kit
- Sanitisers
- PPE
- Safety manual

### Method:

1. Check the following points prior to installation of the refrigeration unit:
  - The condenser coil (air inlet) should not restrict air flow to the coil. A minimum of 12" distance to be maintained (18" is preferred) between the face of the coil and the wall or other vertical obstruction.
  - A minimum of 6" distance to be maintained on the sides to allow access to the housing clamps.
  - A minimum of 24" distance to be maintained on the louvered end (air outlet) for clearance when opening housing and for ease of maintenance.
  - Do not position multiple units close to each other to avoid air discharge of one going into the condenser air intake of another.
2. Remember the following points when installing the evaporator:
  - Do not install the evaporator too close to door openings to prevent icing problems.
  - Keep the minimum clearance between evaporator and the walls equal to or greater than the coil height for proper air flow and service access.
  - Refer to the evaporator coil drawing dimension for mounting hole's location.
  - Install washers and secure with nuts.
  - Tighten until the coil is firm against the ceiling.
  - The evaporator coil must be level.
3. After installing the evaporator, install the refrigerant piping. Remember that the condensing unit must remain sealed and pressurized from the manufacturer until piping is complete and final connections are ready to be made.
4. Use only refrigeration grade copper tubing, (ACR), type "L", bright annealed, dehydrated, and properly sealed against contamination. Soft temper tubing may not be used for field interconnection of refrigeration components (condensing unit to evaporator assembly). Take extreme care to keep refrigeration tubing clean and dry prior to installation. Use an appropriate size tube cutter (DO NOT CUT TUBING WITH A SAW).
5. Keep the suction lines slope down 1/2 inch for each 10 feet of horizontal run towards the compressor.

6. If any portion of the suction line rises above the exit elevation of the evaporator, P-type oil traps should be located at the base of each suction riser for proper oil return to the compressor.
7. During brazing, it is a must to pass dry nitrogen through the lines at low pressure to prevent scaling and oxidation inside the tubing and fittings. Remove all flux from the joints after brazing.
8. Add the proper refrigerant to 60 psig, then boost to 175 psig with dry nitrogen. Leak check all joints with an electronic leak detector or a halide torch. If leaks are found, relieve the pressure, and make repairs as necessary and recheck.

**Precautions:**

- During the testing period you should check the temperature holding range against the control setting.
- On low temperature units, check the defrost control system to see that all ice is removed from the coil during each defrosts cycle.
- Perform checks of door operation and all other component operations.

**Observation:**

Sr. No.	Installation completion check list	Yes/No
1	Check high-low pressure control settings	
2	Check setting of defrost timer Medium temperature 2 to 4 defrosts/24 hours with 35 minutes fail safe. Low temperature 3 to 4 defrosts/24 hours with 44 minutes fail safe	
3	Check operating pressure	
4	Check electrical requirements of unit to power supply voltage	
5	Set temperature control for desired temperature range	
6	Check setting of thermostatic expansion valve for proper operation	
7	Check sight glass for proper refrigerant charge	
8	Check compressor oil level	
9	Check system for proper defrost settings and operation	
10	Check condensing unit for vibrating or rubbing tubing. Dampen or clamp as required	
11	Open all valves completely counter clockwise	
12	Check packing nuts on all service valves	
13	Replace all service valve caps and latch unit covers	

**Conclusion:**

Sr. No.	Installation Activities	Installed Successfully (Yes/No)
1	Evaporator	
2	Compressor	
3	Condenser	
4	Expansion valve	
5	Refrigerant	

## Practical

**Objective**

1. Execute the process for charging refrigerant in the refrigeration system

**Materials required for the practical:**

- Refrigeration unit
- Refrigerant as per manufacturer specification

**Method**

1. In low side refrigerant charging, connect the canister supplying refrigerant to the gauge service port and open it.
2. Check that the HVAC equipment or appliance is running which pumps refrigerant gas from the supply source in parallel with pumping from the outlet of the evaporator coil.
3. Keep the refrigerant canister upright so that only gas leaves the canister.
4. In high side refrigerant charging when charging an air conditioner, heat pump, or refrigeration appliance, keep the system being turned OFF.
5. Keep the refrigerant gas canister is placed upside down so that only pure liquid refrigerant leaves the canister.
6. Keep in mind that once you start the system running you will not be able to charge on the high side because the head pressure out of the compressor will be higher than the evaporation pressure in the canister which will push refrigerant back into the canister.

**Precautions:**

- Keep the system turned off while charging the unit.

**Observation:**

Sr. No.	Starting the refrigeration unit
1	
2	
3	
4	
5	
6	

**Conclusion:**

Sr. No.	Low side refrigerant charging	High side refrigerant charging
1		
2		
3		
4		
5		

## UNIT 4.3: Basic Calculations

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. Calculate the load in a cold storage refrigerant.

### 4.3.1 Basic Calculations

Cold store refrigeration load

#### Specification

- Dimensions 20 m x 10 m x 5 m = 1 000m<sup>3</sup>
- Insulation thickness (0.25 m)
- External store surface area (771.5m<sup>2</sup>)
- Maximum ambient temperature (35°C)
- Store temperature (-30°C)

#### Load calculation

1. Insulation heat leak through walls, roof and floor
  - Conductivity of polystyrene 0.033 kcal/h mC
  - Temperature difference between ambient and store 35°C and -30°C = 65°C
  - Thickness of polystyrene = 0.25 m
  - Surface area of store = 771.5 m<sup>2</sup>
  - Heat leak =  $\frac{771.5 \times 65 \times 0.033}{0.033} = 7422 \text{ kcal/h}$
2. Air changes
  - Average of 2.7 air changes in 24 h
  - Store volume = 1000m<sup>3</sup>
  - Heat gain (35C and 60% R.H. air) 40 kcal/m<sup>3</sup>
  - Air change heat gain =  $\frac{1000 \times 2.7 \times 40}{0.033} = 4500 \text{ kcal/h}$
3. Lights (left on during working day)
  - 1000W = 860 kcal/h
4. Men working
  - 1 man working at -30°C gives off 378 kcal/h
  - 2 men working is equivalent to 756 kcal/h
5. Product load
  - 5.5 kcal/kg for fish load at an average temperature of -20°C
  - Fish loaded per day 35 000 kg
  - Product load =  $\frac{3500 \times 5.5 \times 24}{24} = 8020 \text{ kcal/h}$
6. Fan load
  - 3 x 250W = 644 kcal/h



#### 7. Defrost heat

- 1 defrost of 8440 W for 1 h (recovered over 6 h) = 1 209 kcal/h
- Total calculated refrigeration load (sum of Items 1 to 7) = 23411 kcal/h
- Total refrigeration requirement with allowances  $\frac{23411 \times 24}{18} = 31215$  kcal/h

## UNIT 4.4: Storage of Food in Cold Storage

### Unit Objectives



At the end of this unit, the trainee will be able to:

1. Identify the types of food that can be stored in cold storage
2. State the storage parameters for various type of food.

### 4.4.1 Storage of Food in Cold Storage

Food can be divided into three groups of products:

1. Foods that are alive at the time of storage, distribution and sale e.g. fruits and vegetables
2. Foods that are no longer alive and have been processed in some form e.g. meat and fish products
3. Commodities that benefit from storage at controlled temperature e.g. beer, tobacco, khandsari, etc.

Storage parameters of some of the Agricultural Crops

Species	Temperature (°C)	RH (%)	O <sub>2</sub> (%)	Co <sub>2</sub> (%)	Time
Cherry	0	95	3-10	10-12	30 Days
Kiwi	0	98	2	4-5	7 Months
Peach	-0.5/0	95		4-5	40 Days
Plum	0	95	2	5	45 Days

Table 4.4.1: Storage parameters

Handling of food items

- Before being put into storage, produce should be sorted and graded with regards to quality (only high quality produce should enter the storage facility).
- Produce needs to be cleaned (with clean water in order to avoid the spread of molds and fungi) before being put into storage containers and entering the storage rooms. Dirt bears the potential of introducing pests into the storage facility.
- Time span between harvest and the placement into storage needs to be kept as short as possible.

Storage Mix

Different produce has different storage demands with regards to factors, such as optimum temperature, level of relative humidity, levels of ethylene production and sensitivity, and chilling sensitivity. Hence, the storage of single commodities is less complex than the storage of multiple commodities; however, the latter can still be the more viable option depending on external circumstances.

Besides damages due to mismatches in temperature, odors can be transmitted and ripening and decay can be affected through the exposure to ethylene, which can result in changes in colour, flavour and texture. Further, only high quality produce should be 'allowed' in the cold storage and produce should be sorted accordingly.

Examples of odour transfers which should be avoided:

- apples/pears with celery, cabbage, carrots, potatoes or onions
- celery with onions or carrots
- citrus with strongly scented vegetables
- pears/apples with potatoes as the former acquire unpleasant taste
- green pepper will taint pineapples
- onions, nuts, citrus, potatoes should be stored separately

## UNIT 4.5: Methods to Monitor Food in Cold Storage

### Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the methods to monitor and control the cold storage facility
2. State the procedure for charging refrigerant in the refrigeration system.

### 4.5.1 Methods to Monitor Food in Cold Storage

The following points should be kept in mind while monitoring the cold storage facility:

- The nature of the products and the volumes/quantities to be stored
- The level of electronic control of the refrigerator unit, i.e. the ability of the unit to control temperature within specified limits
- The power back-up facilities for the unit itself and for the temperature monitoring and recording system
- The condensate from the chiller units should not be collected inside the cold store in an open vessel
- The internal layout of the cold storage area should ensure that the product is only stored in areas shown by temperature mapping to provide adequate temperature control
- Procedures should ensure that product is not stored directly on the floor. It should also be ensured that the storage area is not loaded in such a way as to prevent or restrict air flow and so reduce the cooling ability of the unit. The capacity of the storage area should be sufficient for the purpose
- The type of temperature monitoring equipment used (e.g., maximum/minimum thermometers (max/min); continuous electronic monitoring; temperature probes etc.) and their suitability and quantity with respect to the level of product risk; auto-defrost should be available and the temperature within the unit should not be affected during the defrost cycle
- Recording probes should be independent of controlling probes
- Recording sensors/probes are to be placed in locations with the greatest temperature variability as determined by temperature mapping studies; these should also encompass the hot/cold spots within the system
- The procedures for checking functionality and compliance of the unit with its temperature specifications (i.e., daily checks)
- The temperature records generated and the procedure for their review and approval
- Recording/monitoring probes should be calibrated regularly (i.e., certified that they are operating correctly and the certification should be traceable to a national standard) to cover the operating range. A minimum of a three-point calibration is preferable and should be carried out on an annual basis
- The maintenance requirements for the system and potential down-time for maintenance to be conducted
- The installation of an alarm/alert system, and the procedure for responding to those

## UNIT 4.6: Quality Assessment

### Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the process of quality assessment.

### 4.6.1 Quality Assessment

#### Steps for Quality Control and Assessment Measures

**Step 1:** Check contamination with the sample received in the factory.

**Step 2:** Plan for delivery and have tools for receiving ready.

**Step 3:** Visually inspect all items and look for signs of container damage.

**Step 4:** Check and record temperatures of frozen and refrigerated items.

**Step 5:** Check off items on invoice for the quantity of receiving with actual quantity.

**Step 6:** Check for substituted products.

**Step 7:** Reject unacceptable goods and note this rejection on the invoice.

**Step 8:** Mention the date of the food packages received in the storage.

**Step 9:** Store items using FIFO(First In, First Out). To do this, store new supplies behind old supplies so that the old supplies are used first.

**Step 10:** Store food and chemicals in separate areas.

**Step 11:** Mention date on foods and place new foods behind current stock.

**Step 12:** Keep food in clean, sturdy containers to prevent pest and rodent infestation.

**Step 13:** Keep food off the floor and away from the walls.

**Step 14:** Keep the shelving and floor clean.

**It is very important to check temperature when the goods are received. You can take the temperature of foods received by:**

- Placing the thermometer under the top layer of goods
- Placing the thermometer through a hole in an unopened case
- Placing the thermometer inside the package
- Placing the thermometer between the folds of a folded package

**It is very important to check temperature when the goods are received. You can take the temperature of foods received by:**

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- Placing the thermometer through a hole in an unopened case
- Placing the thermometer inside the package
- Placing the thermometer between the folds of a folded package

## Freezing

Freezing can preserve the foods;

- Taste
- Texture
- Nutritional value

The major considerations for optimum quality of frozen foods can be described under three stages;

- Pre-freezing
- Freezing
- Post-freezing

Legislations are designed to ensure effective control of safety and quality. General legislative directives relevant to cold chain operations include-

- **The food safety act** - covering descriptions of safety, quality, description offences, defence and enforcement and penalties
- **Compositional standards** - covering specific product categories, e.g. quick-frozen foods, meat products, milk and dairy products, bread and bakery products
- **Labelling, presentation and advertising** - covering nutritional declarations, ingredient declarations, minimum durability, e.g. 'best-before', 'use-by' dates
- **Additives and contaminants** - e.g. colours and sweeteners, pesticides and residues, metals
- **Packaging directives** - For example, materials in contact with foods, packaging waste
- **General food hygiene** - covering basic food hygiene and standards, guidance on temperature control and specific product needs within the cold chain

## UNIT 4.7: Repair and Maintenance

### Unit Objectives

At the end of this unit, the trainee will be able to:

1. Identify faults in a refrigeration system
2. State the procedure for repairing and maintenance of the refrigeration system.

### 4.7.1 Repair and Maintenance

#### Common Faults:

#### 1. Compressor Starts but Stops immediately

When the compressor in the reefer circuit starts and suddenly stops, it can be because of the following reasons:

- Low pressure cut out gets activated
- Defective oil pressure cut out
- Defrosting timer is getting activated frequently
- The lube oil level is below required level
- Foaming of oil leading to reduced oil pressure
- Motor overload cutouts are activating

#### 2. Compressor is Running Continuously

- The function of compressor in a refrigeration system is to act as a pump to circulate the refrigerant in the cooling circuit
- It can happen that to maintain the cooling temperature in the rooms, the compressor is running continuously

**If this happens then the following can be the causes:**

- Refrigerant not sufficient for cooling evaporator (Ensure thermostatic expansion valve is working properly and clean the filters inside TEV)
- Thermostat low pressure cut-out not activated at low temperature/ pressure (Correctly set the LP cut-out to correct setting)
- Refrigerant charge is low in the circuit (Check for leakage of refrigerant and charge with required refrigerant)

#### 3. Unusual Sound from Compressor: One of the most common problems in any machinery is abnormal sound coming from some of its parts. This may be due to trouble with mechanical components inside the compressor or due to the reasons stated below:

- The capacity control setting is too high, leading to knocking sound during starting
- The oil pressure is low
- Incorrect alignment of compressor and motor
- Loose foundation
- Loosening of driving belt

**4. High Compressor Discharge Temperature:** It may happen that all the provision rooms or cargo holds are maintained at correct temperature, but in doing so the discharge temperature of the compressor is going above the limit. This problem may arise due to following reasons:

- Excessive suction temperature due to less refrigerant in the circuit
- Leak in the discharge valve leads to generation of heat
- Leak in the safety valve
- Open bypass between suction and discharge

**5. Evaporator Coil Icing:** Another common problem is icing of the evaporation coils which may happen due to:

- Too low temperature
- The coil capacity is less
- Defrost is not operational

#### **Maintenance procedures**

- Keep the compressor clean by regularly washing with mild soapy water solution
- Check operation of thermostat and defrost system (if fitted)
- Keep door seals clean, avoiding build-up of material between folds and at corners
- Remove build-up of ice (use the defrost system or a blunt scraper)
- Keep drains free of debris
- Check appliance level to give a small fall to the rear (no more than 4mm) to ensure door closure
- Clean condenser coil (fins), ensure fins and cooling fan and any grills are free of dust fluff and debris

#### **Repairs to the cooling system**

- If pipework of a sealed mechanical system is broken into, the reliability is likely to be severely compromised.
- On a cost basis, where possible, it is advised that repairs be limited to electrical systems, thermostats, defrost timers and start relays; otherwise it is recommended to replace the refrigerator or freezer.
- In the case of absorption refrigeration systems, which are fully sealed and under relatively high pressure, repairs can only be made to the heater and thermostat, though inverting the entire refrigerator for a few hours can sometimes bring an apparently dead unit back to life.
- Where refrigerators and freezers are being used to store high value products, consider installing a temperature alarm system. An alarm can give sufficient time for the contents to be moved to an alternative store or to a cold box lined with coolant packs; this can prevent the products from being compromised.

#### **Refrigerated containers:**

- Visual check on skin integrity covering insulation
- Check integrity of door seals and locking mechanism
- Check drains
- Check fresh air setting
- Check temperature setting



## Exercise



### 1. Arrange the sequence of the refrigeration cycle in the correct order

- i. Cooling and condensation of the refrigerant to liquid.
- ii. Expansion and partial evaporation of the liquid into a lower pressure which causes cooling.
- iii. Compression of the refrigerant gas.
- iv. Re-compression of the vapour to begin the cycle again.
- v. Continued evaporation of the liquid in the 'cold box' - further heating by removal of sensible heat from the item being cooled, to provide the latent heat of vaporization of the refrigerant

### 2. Answer the following Questions:

- i. List the five basic components of a refrigeration system
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
  - d. \_\_\_\_\_
  - e. \_\_\_\_\_

### 3. Write the procedure for calibrating equipment in the correct order:

- i. Place certified or calibrated thermometer in the oil or water bath and adjust the bath to the temperature range of the thermometer to be tested.
- ii. Obtain a thermometer that is certified or calibrated for the temperature ranges that will be used during standardisation procedure.
- iii. Record the reading from of the thermometer being tested and the temperature of bath.
- iv. After the temperature has stabilised, place the thermometer being tested next to the certified or calibrated thermometer.
- v. If needed, adjust thermometer to correct temperature and retest. A correction factor may be applied to non-adjustable thermometers up to  $\pm 5.00F$  or  $\pm 2.80C$ .

### 4. Given below are the storage parameters for some agricultural crops. Write for how much time each crop can be stored:

Species	Temperature ( $^{\circ}C$ )	RH (%)	O <sub>2</sub> (%)	Co <sub>2</sub> (%)	Time
Cherry	0	95	3-10	10-12	
Kiwi	0	98	2	4-5	
Peach	-0.5/0	95		4-5	
Plum	0	95	2	5	

**5. Choose the correct option and fill in the blanks.**

- a. Recording sensors/probes are to be placed in locations with the greatest \_\_\_\_\_ variability as determined by temperature mapping studies.
- i. pressure
  - ii. temperature
  - iii. oxygen
  - iv. water
- b. The Cold Storage Technician must install an \_\_\_\_\_ system, and the procedure for responding to those.
- i. air
  - ii. water
  - iii. oxygen
  - iv. alarm
- c. A minimum of a three-point calibration is preferable and should be carried out on an \_\_\_\_\_ basis.
- i. daily
  - ii. weekly
  - iii. monthly
  - iv. annually
- d. The refrigerant canister is kept upright so that only \_\_\_\_\_ leaves the canister.
- i. gas
  - ii. water
  - iii. air
  - iv. soil
- e. When \_\_\_\_\_ an air conditioner, heat pump, or refrigeration appliance from the high side, the system being serviced is turned OFF.
- i. charging
  - ii. recording
  - iii. installing
  - iv. maintaining
- f. The function of compressor in a refrigeration system is to act as a pump to \_\_\_\_\_ the refrigerant in the cooling circuit.
- i. calibrate
  - ii. circulate
  - iii. install
  - iv. maintain
- g. Keep the \_\_\_\_\_ clean by regularly washing with mild soapy water solution.
- i. compressor
  - ii. evaporator
  - iii. condenser
  - iv. sensor
- h. Where refrigerators and freezers are being used to store \_\_\_\_\_ value products, consider installing a temperature alarm system.
- i. low
  - ii. high
  - iii. medium
  - iv. very high
- i. It is very important to check \_\_\_\_\_ when the goods are received.
- i. pressure
  - ii. temperature
  - iii. oxygen
  - iv. air

- j. Store food and chemicals in \_\_\_\_\_ areas.
- i. common
  - ii. dry
  - iii. wet
  - iv. separate
- k. Freezing can preserve the foods \_\_\_\_\_.
- i. taste
  - ii. texture
  - iii. nutritional value
  - iv. taste, texture and nutritional value
- l. The Food Safety \_\_\_\_\_ covers descriptions of safety, quality, description offences, defence and enforcement and penalties
- i. act
  - ii. law
  - iii. right
  - iv. standard

## Notes



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[https://www.youtube.com/watch?v=\\_osRX0AWLYQ](https://www.youtube.com/watch?v=_osRX0AWLYQ)

Raw material Storage and warehousing



<https://www.youtube.com/watch?v=GwGeTWYIOy&t=16s>

Basic storage and transportation



# 5. Complete Documentation and Record Keeping Related to Cold Storage Facility



Unit 5.1 - Documentation and Record Keeping



## Key Learning Outcomes



**At the end of this unit, the trainee will be able to:**

1. State the need for documenting and maintaining records of raw materials, process, and finished products
2. State the method of documenting and recording the details of raw material to final finished product
3. State the functions of ERP system
4. Observe the various facilities, machineries and cold storage process in the food processing industry.

## UNIT 5.1: Documentation and Record Keeping

### Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the need for documenting and maintaining records of raw materials, process, and finished products
2. State the method of documenting and recording the details of raw material to final finished product
3. State the functions of ERP system.

### 5.1.1 Need for Documentation

Every organisation has to maintain records of ingredient procurement, production processes, and sales. This is to ensure that the business runs effectively and is profitable. Listed below are some reasons why there is a need for documentation:

- It gives detailed knowledge about running of the business
- It helps to control product quality
- It helps to keep track of the money invested in the business
- It helps to identify the separate costs of product ingredients
- It helps to identify the production cost of a particular process
- It helps to ensure that quality assurance procedures are followed
- It helps to ensure that the production unit is running smoothly/effectively
- It works as an evidence for legal procedures
- It helps to set an appropriate product price
- It helps to take corrective measures at the right time

### 5.1.2 How to Keep Records?

Every food processing unit follows a more or less similar way of keeping records. Production records keep a log of:

- the quantity and type of ingredients
- the processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- the product quality

**Product quality can be maintained only when:**

- The same quantity and quality of ingredients are mixed in every batch
- A standard formulation is used for every batch
- Standard process parameters are applied for every batch

**Every batch of food is given a batch number. This number is recorded in:**

- stock control books (where ingredient procurement is noted)
- processing logbooks (where production process is noted)
- product sales records (where sales and distribution is noted)

The batch number must correlate with the product code number, which is printed on labels. This helps the processor to trace any fault found in a batch back to the raw material used or the production process.

Example of a stock control book:

• Product Name		• Batch Number		
• Raw material*	• Supplier	• Results of inspection for:		
		A	B	C

Table 5.1.3: Example of a stock control book:

## 5.1.3 Introduction to ERP Solutions

### ERP System

ERP stands for Enterprise Resource Planning. ERP is an enterprise-wide information system that facilitates the flow of information and coordinates all resources and activities within the business organisation.

### ERP Functions

Functions typically supported by the system include:

- manufacturing
- logistics
- accounting
- inventory
- distribution
- shipping
- invoicing

A wide variety of business activities including sales, marketing, billing, production, inventory management, human resource management, and quality control are supported by these systems.

At present, many companies in food processing sector are using ERP systems of different ERP system providers. Some of the top ERP systems used by the organisations are:

- Batchmaster Manufacturing
- Sage
- SAP
- Plex
- Process Pro
- Sys Pro
- Microsoft Dynamics
- Deacom
- Netsuite



## Exercise

### 1. Multiple Choice – Tick the correct options

a. What is the need for documentation?

i. It gives detailed knowledge about running of the business.	<input type="checkbox"/>
ii. It helps to control product quality.	<input type="checkbox"/>
iii. It helps to keep track of the money invested in the business.	<input type="checkbox"/>
iv. It helps to identify the separate costs of raw material or product ingredients.	<input type="checkbox"/>
v. It helps to identify the production cost of a particular process.	<input type="checkbox"/>
vi. It helps in raw material storage.	<input type="checkbox"/>
vii. It helps to ensure that quality assurance procedures are followed.	<input type="checkbox"/>
viii. It helps to ensure that the production unit is running smoothly/effectively.	<input type="checkbox"/>
ix. It helps to clean the food handling equipment and machineries.	<input type="checkbox"/>
x. It works as an evidence for legal procedures.	<input type="checkbox"/>
xi. It helps in sending the produce to the market.	<input type="checkbox"/>
xii. It helps to set an appropriate product price.	<input type="checkbox"/>
xiii. It helps to take corrective measures at the right time.	<input type="checkbox"/>

b. Production records keep a log of:

i. The quantity and type of raw materials	<input type="checkbox"/>
ii. The amount of finished products stored	<input type="checkbox"/>
iii. The quantity and type of ingredients used	<input type="checkbox"/>
iv. The processing conditions in which production took place (e.g. the temperature set or the air pressure applied)	<input type="checkbox"/>
v. The product quality	<input type="checkbox"/>

### 2. Match the columns

Column A	Column B
a. Every production process completed is given a number	i. Stock control books
b. The details of raw material procurement is noted	ii. Facilitates flow of information
c. The details of production process is noted	iii. Quality procedures are followed
d. The details of product sales is recorded	iv. Plex
e. Records serve as	v. Processing log books

vi. Properly maintained records help to identify whether	f. Sales and distribution log
vii. ERP system	g. Legal evidence
viii. Enterprise Resource Planning	h. Batch number

## Notes



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Scan the QR codes or click on the link to watch the related videos



<https://www.youtube.com/watch?v=kcpGIHBpphA>

Audit, Documentation and Record keeping



## 6. Employability Skills



DGT/VSQ/N0101

Scan the QR codes or click on the link to watch the related videos








<https://www.skillindiadigital.gov.in/content/list>







Employability Skills



## 7. Annexure



Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
1. Introduction	UNIT 1.2: Introduction to the Food Processing Industry	1.2.1 Food Processing	11	<a href="https://www.youtube.com/watch?v=J-2EiMVNtpM">https://www.youtube.com/watch?v=J-2EiMVNtpM</a>	 Overview of food processing industry
	UNIT 1.4: Attributes of a Cold Storage Technician	1.4.1 Role and Responsibilities	11	<a href="https://www.youtube.com/watch?v=Rkym0HNt9xE">https://www.youtube.com/watch?v=Rkym0HNt9xE</a>	 Roles and Responsibilities
	UNIT 1.1: Introduction to the Training Programme	1.1.1 Purpose and Benefits of the Training Programme	11	<a href="https://www.youtube.com/watch?v=Zl1u2C-yhly">https://www.youtube.com/watch?v=Zl1u2C-yhly</a>	 Orientation video
2. Food Safety, Hygiene and Sanitation	UNIT 2.1: Sanitation and Hygiene	2.1.1 Personal Sanitation	27	<a href="https://www.youtube.com/watch?v=WYosZ4z-ru5Y&amp;t=101s">https://www.youtube.com/watch?v=WYosZ4z-ru5Y&amp;t=101s</a>	 Introduction to food safety
	UNIT 2.3: Good Manufacturing Practices (GMP)	2.3.1 Good Manufacturing Practices (GMP)	27	<a href="https://www.youtube.com/watch?v=R-S4A-uczS6E&amp;t=552s">https://www.youtube.com/watch?v=R-S4A-uczS6E&amp;t=552s</a>	 Introduction to GMP, GHP & FSMS

Module No.	Unit No.	Topic Name	Page No	Link for QR Code (s)	QR code (s)
3. Prepare and Maintain Work Area and Refrigeration Equipments	UNIT 3.1: Equipment used in Re-frigeration Process	3.1.1 Equipment Used in the Refrigeration Process	45	<a href="https://www.youtube.com/watch?v=uhq6R6qKNZM">https://www.youtube.com/watch?v=uhq6R6qKNZM</a>	 Overview of controlled atmosphere storage
		3.1.1 Equipment Used in the Refrigeration Process	45	<a href="https://www.youtube.com/watch?v=6nzC8DIhwyU">https://www.youtube.com/watch?v=6nzC8DIhwyU</a>	 Machine and equipments used in cold storage
4. Handle Cold Storage Facility for Storing Food	UNIT 4.4: Storage of Food in Cold Storage	4.4.1 Storage of Food in Cold Storage	67	<a href="https://www.youtube.com/watch?v=_osRXOAWLYQ">https://www.youtube.com/watch?v=_osRXOAWLYQ</a>	 Raw material Storage and warehousing
	UNIT 4.1: Basic Principles of Refrigeration	4.1.1 Basic Principles of Refrigeration	67	<a href="https://www.youtube.com/watch?v=GwGeTWY-10oY&amp;t=16s">https://www.youtube.com/watch?v=GwGeTWY-10oY&amp;t=16s</a>	 Basic storage and transportation
5. Complete Documentation and Record Keeping Related to Cold Storage Facility	UNIT 5.1: Documentation and Record Keeping	5.1.2 How to Keep Records?	74	<a href="https://www.youtube.com/watch?v=kcpGIHBpphA">https://www.youtube.com/watch?v=kcpGIHBpphA</a>	 Audit, Documentation and Record keeping
<b>Employability Skills</b>				<a href="https://www.skillindiadigital.gov.in/content/list">https://www.skillindiadigital.gov.in/content/list</a>	









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