Dairy Products Processing Level II

Based on October, 2019, Version 2 Occupational standards

Module Title: - Working in a freezer storage room

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LG #56	LO #1- Prepare to enter a freezer storage environment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- ✓ Preparing to enter a freezer storage environment
- ✓ Identifying and monitoring equipment operation in a freezer storage environment
- ✓ Handling frozen product safely
  Responding to emergencies

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- ✓ Prepare to enter a freezer storage environment
- ✓ Identify and monitor equipment operation in a freezer storage environment
- ✓ Handle frozen product safely
- ✓ Respond to emergencies

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Identifying appropriate clothing and footwear

Introduction

Freezing

It is one of the oldest and most widely used methods of food preservation, which allows preservation of taste, texture, and nutritional value in foods better than any other method. The freezing process is a combination of the beneficial effects of low temperatures at which microorganisms cannot grow, chemical reactions are reduced, and cellular metabolic reactions are delayed.

Freezing of foods is one of the most prominent technologies followed in the Cold Chain, for preservation of foods for longer periods.

A large number of foods which can be processed and frozen and stored at sub zero temperature. For distribution to the market and consumers Food Freezing and Storage is practiced in various food sectors e.g. milk and milk products (cheese, ice cream, butter, yogurt, etc)

1.1. Identifying appropriate clothing and footwear

Working in cold rooms and freezer rooms can be dangerous. This is particularly the case in hot climates where people wear thin clothes and may have no experience of intense cold. In all climates it is important to take the following eight precautions.

Never enter a freezer room without wearing protective clothing, including gloves. Never remain inside on your own for more than a few minutes, otherwise your body will become chilled and your reactions will become slow.

To understand why personal protective equipment is important? , how to select, use, and maintain equipment and clothing to protect the body against physical hazards? The result should be the use of proper protective equipment whenever required on the job.

Suggested Materials to have on Hand samples of any protective equipment used on job, such as:

- Freezer coats and pants, gloves, etc.
- Hard Hats
- Safety Boots

Clothing should be selected to suit the temperature, weather conditions, the level and duration of activity, and job design. These factors are important to consider so that you can regulate the amount of heat and perspiration generated while working.

Suitable personal protective equipment (PPE) – selection of PPE should take account of the temperature, length of exposure, type of operation and personal preference.

Guideline to the recommended personal protective equipment to be worm in the cold environment:

Chilling environment down to -5^{o}C, 150gm chill protective clothing includes:

- Thermal undergarment to personal preference
- Jacket and trousers or quilted in all one coverall
- Light weight gloves
- Safety boots or shoes
- Head protector- baseball cap or thin insulated hat or safety helmet

Frozen environment down to -18^{o}C and below, 235gm frozen protective clothing includes:

- Thermal undergarment to personal preference
- Jacket and salopettes in all one coverall, both with knee protector
- Cold store gloves with thermal liners
- Insulated safety boots with thermal socks
- Safety helmet with thermal liner, thermal balaclava and thermal hood.

Wrap up

Protective equipment is an essential part of your on-the-job safety. You've received a lot of training on what types of equipment you need. But none of that will do any good unless you use protective equipment when you are supposed to.

Protection against frozen room Hazards

Clothing

Appropriate freezer gear is required for all employees working in the freezer or cooler. The clothing must be maintained to prevent it from catching on racks or from not providing the protection it was designed for.

Jacket

The cold store jacket has been designed to provide thermal protection and maximum comfort whilst working in extreme temperatures of up to -50°C. Cotton is not recommended for cold store clothing as it tends to get damp or wet quickly, and loses its insulating properties. Synthetic fibers, on the other hand, retain heat when wet so are perfect for working in cold environments. The outer of the jackets are also constructed from 100% polyester rip stop fabric making the jackets strong, durable and hard wearing, they are also water repellent. Multiple layers provide better protection than a single thick garment. The air between layers of clothing provides better insulation than the clothing itself. The cold store jackets are insulated by two layers of 150g 3M thinsulate wadding.

Salopettes

The cold store salopettes have been constructed from a hard-wearing, strong, durable and water repellent, fabric, incorporating features to ensure they are as comfortable as possible for the wearer and designed to complement the new cold store jackets.

These salopettes have also been designed with the wearer in mind and have additional features so that they are easy to wear, for example the concealed leg opening allows the wearer to remove the garment easily over their boots.

Gloves

Frostbite, occurs when your body tissues freeze. This happens when the temperature of the skin reaches below 0ºC. Toes, fingers, ears and nose are at greatest risk because these areas do not have major muscles to produce heat.

In cold conditions the body will preserve heat by favoring the internal organs, reducing the flow of blood to the extremities under cold conditions.

Hands and feet also tend to get cold more quickly than the torso because they are more likely to be in contact with colder surfaces than other parts of the body.

Cold room clove

Hard Hats

You must wear hard hats while in the dock areas, freezers, coolers, production areas, battery changing areas, and in every other sections of the building that have overhead exposures and/or bumping exposures. No stickers (except for your name), no drawings, and no artwork of any type are allowed to be displayed on the hard hat. **No exceptions**. The hard hat must be in good condition with not defects and must be properly worn.

It has long been recognized that the majority of heat loss in the body is through the head so this is a key area to protect when working in a cold environment. By wearing a hat or helmet liner, it allows the body to retain heat and keep warm.

When working in temperatures below 0°C the body starts to try and keep organs warm by reducing blood flow to areas furthest from the heart including, ears, fingers and toes. Ears are a key area at risk from frostbite because they do not have any muscles to produce heat and keep them warm.

Wearing a suitable helmet liner can also help bodies to stay warm in cold environments by reducing draughts to the head and neck area by forming a seal with your jacket collar allowing you to retain heat. For working in very cold environments helmet liners with face warmers are also available.

Cold Store Helmet Liner

Poly-cotton outer with insulation and fleece lining

- This liner is designed to be worn with the Champion plus Safety Helmet (purchased separately). It simply sits between the head harness and the shell

Safety Shoes

Worn by all employees working in the warehouse are no exceptions**.** Employees are exposed to falling product and material handling equipment constantly. This is a serious problem in the warehouse.

Lined boot to keep feet warm in the coldest temperatures

- Full-grain leather uppers for durability
- Recycled insole board
- Shock absorbing lightweight PU midsole
- PU/rubber sole unit for excellent abrasion and slip resistance
- Fur lined
- Aluminized insole to keep the underside of the feet warm when the boot is in contact with cold floor surfaces
- PU/rubber construction for a long lasting boot

Cold Store Safety Boot

Thermal Underwear

When working in cold environments clothing should be worn in multiple layers which provide better protection than a single thick garment. The inner layer should provide insulation and be able to “wick” moisture away from the skin to help keep it dry.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4pts)

1. What hazard do safety helmet protect against?
   A. Strong light
   B. Dust
   C. reducing draughts to the head and neck area
   D. All
2. What is possible for gloves to protect against?
   A. Strong light
   B. Cold or heat
   C. Rotating parts
3. What rule applies to the use of protective clothing?
   A. Replace your clothing once a year.
   B. Immediately repair or replace torn/worn clothing.
   C. Immediately replace torn/worn clothing at your own cost.
4. Safety shoes feet warm in the coldest temperatures:
   A. Full-grain leather uppers for durability
   B. Recycled insole board
   C. rubber construction for a long lasting boot
   D. All

Test II: Short Answer Questions (5pts)

1. List personal protective equipment used in frozen storage room?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Information Sheet 2- correctly fitting clothing and footwear

2.1. Correctly fitting clothing and footwear

All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable to wear will encourage employee use of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size for each employee. If several different types of PPE are worn together, make sure they are compatible. If PPE does not fit properly, it can make the difference between being safely covered or dangerously exposed. It may not provide the level of protection desired and may discourage employee use.

PPE should fit properly, snug but not tight or loose, and it should not impede movement or communication. Select the right PPE for the task. Do not wear PPE that could potentially cause injury, such as loose fitting gloves that could be caught in moving parts of equipment or machinery. For loose fitting gloves, tape or fold a cuff on the gloves to prevent chemicals from running down the users arm.

Protective equipment doesn't eliminate a hazard; it protects you from the hazard if you:

- ✓ Select the right equipment for the hazard
- ✓ Make sure the equipment fits properly
- ✓ Wear the equipment when you might be exposed to the hazard
- ✓ Maintain the equipment so that it can do its job.

Check what special clothing is available for the people who work in the store.

- ✓ Are there warm jackets? Are there warm trousers? Are there warm gloves? Are there enough sets for the people who work in the store? Do they fit the people who work in the store? If the answer to any of these questions is “No”, obtain more clothing.

- ✓ Are the clothes kept in a safe place where they are not likely to be lost, stolen or damaged? If they are not kept in such a place, arrange for the provision of a suitable safe storage place.

Use the special low-temperature clothing provided by your employer. Choose clothes according to the job, not only the temperature. Report to your employer any loss or obvious defect with the personal protective equipment supplied to you. Ensure your clothing is kept clean and in good repair so that it will work properly.

Don't wear clothing that is too small or too tight as this restricts blood flow, preventing warm blood entering your extremities.

If the workplace is too fast or if the type and amount of clothing is not properly selected, excessive sweating may occur. The clothing next to the body will become wet and the insulation value of the clothing will decrease dramatically.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3pts)

1. PPE protects you from the hazard if you:
   A. Select the right equipment for the hazard
   B. Make sure the equipment fits properly
   C. Wear the equipment when you might be exposed to the hazard
   D. Maintain the equipment so that it can do its job.
   E. All
2. Which one is not true about PPE?
   A. Select the right equipment for the hazard
   B. Make sure the equipment fits properly
   C. Wear the equipment when you might not be exposed to the hazard
   D. Maintain the equipment so that it can do its job.

3. Don't wear clothing that is too small or too tight because of:
   A. Restricts blood flow
   B. Preventing warm blood entering your extremities
   C. The insulation value of the clothing will decrease dramatically
   D. All

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Information sheet 3 - Conducting checks and inspections

3.1. Conducting checks and inspections

Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

- When PPE is necessary?
- What PPE is necessary?
- How to properly put on, take off, adjust and wear the PPE?
- The limitations of the PPE
- Proper care, maintenance, useful life and disposal of PPE
- Inspection for faults / integrity

You should make sure that each worker demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete.

Do not wear PPE outside of work area/frozen room areas to prevent spreading contamination to other areas.

The PPE must be inspected for defects every time it is put on. Look for symmetry; does each side look like a mirror image of the other or is one side distorted? Are there any broken, bent, frayed or torn pieces? Are the lenses scratched so they are hard to see through? Is the elastic still springy or is it stretched out?

In addition to visual inspection as above, insulating gloves, sleeves and blankets for electrical workers must be electrically tested. All must be tested prior to initial use, and then every 6 months thereafter for gloves, and every 12 months for sleeves and blankets.

PPE should be clean. If dirty, clean it with soap and warm water. Do not use solvents or abrasives to clean it. Store it out of sunlight in an area where it will be protected and kept clean.

Replace reusable PPE every 2-5 years, earlier if recommended by the manufacturer or if there is a major impact. Replace any defective parts with parts made by the same manufacturer for that equipment. Do not make makeshift repairs. If it cannot be repaired properly, replace it. Do not use paint or glue on PPE. Use decals or stickers to mark it.

Where PPE is in use, routine inspection, cleaning and maintenance is required.

- ✓ The wearer is required to inspect PPE prior to use, for signs of penetration or other damage due to impact, rough treatment or unauthorized alterations which may reduce the degree of safety originally provided.
- ✓ Regularly check respiratory devices (every time before and after use), to ensure that filters / cartridges or air supply are in place and replaced as necessary. This is to ensure that the equipment is ready for use at all times.
- ✓ Clean/decontaminate all re-useable PPE in accordance with the manufactures instructions. However, in the absence of such instruction the item can be washed thoroughly in detergent and warm water using a soft cloth, then rinsed and dried.
- ✓ Avoid using any cleaning agents that are likely to scratch surfaces, particularly the lenses of eye protection equipment
- ✓ Store PPE in clean and sealed containers: such as plastic tubs with lids. This prevents continual exposure to air or other particulates or other environmental factors, for example, prolonged exposure to direct sunlight, that may compromise the effectiveness of the equipment (including filter / cartridges)
- ✓ Ensure that the PPE is kept clean in between usage.

Remove damaged PPE from use, and take to the supervisor to arrange for replacement equipment.

Must do: in related with personal hygiene

- Any person who work in frozen room must
- Bathe daily
- Have clean, well-groomed hair
- Have clean hands and fingernails
- Have clean teeth
- Wear clean, washable outer garments (not street clothing or footwear)
- Wear clean shoes, boots or rubbers (no street footwear)
- Wear suitable hair, and beard and mustache coverings
- Wash hands and exposed portions of arms thoroughly (also sanitize where available):
    - ✓ Before starting work, each time entering the processing area
    - ✓ After using toilet
    - ✓ After eating, smoking or otherwise touching the mouth or anything that has been in the mouth
    - ✓ After touching hair, nose, ears
    - ✓ After working with trash, garbage, dirty utensils, hoses
    - ✓ After sneezing or coughing onto hands (use inside of elbow)
    - ✓ After changing from raw to pasteurized milk surface handling
    - ✓ After any absence from the work area
- Maintain gloves, if they are used in food handling, in an intact, clean, and sanitary condition. Must be changed under any of the conditions listed in # 9.

Do Not:

- Work, if you are diagnosed with or have symptoms of or are a possible carrier of a communicable disease, e.g., experiencing vomiting, diarrhea, sore throat, fever, chills, jaundice (yellowing of skin/eyes) or have had close personal contact with someone diagnosed as having a communicable disease, such as a family member. These symptoms should be reported to your supervisor immediately.
- Work in areas where product or product contact surfaces are exposed if you have infected cuts, abrasions, boils, or any condition that causes flaking of the skin. Consult with your supervisor if such conditions can be bandaged or covered to allow work in these areas.

- Wear jewelry (follow company policy regarding wedding bands or other simple rings).
- Carry any items in shirt pockets; ideally uniforms or work clothes should not have shirt pockets.
- Wear fingernail polish, false fingernails, or excess makeup.
- Eat, drink, smoke, or chew (tobacco or gum) except in an authorized area.
- Pick, scratch, groom, or otherwise handle parts of your body while preparing and packaging the product.
- Spit, while in product-handling areas.
- Store street clothing, personal belongings, or personally owned food and beverage products in preparation, packaging, or storage areas.
- Wear strong cologne, perfume, or other products with strong odors.
- Engage in any activity that may result in allergen cross-contact (allergen contaminated clothing or utensils) or cross contamination with insanitary objects or raw product.

Self check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (5pts)

1. Which one of the following is not true in related with personal hygiene?

   A. Bathe daily
   B. Have clean, well-groomed hair
   C. Have clean hands and fingernails
   D. Have clean teeth
   E. Wear not clean outer garments

2. Which glove material below would be the best choice to protect against cold in frozen room?

A. Leather
B. Cotton
C. Butyl-rubber

3. If a respirator is not available which piece of PPE can be used as a substitute?

A. Dust mask
B. Goggles
C. A & B
D. Neither

Test II: write short answers (6pts)

1. What do you not do in related with personal hygiene before enter to store cold room? (at least 5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

LG #57	LO #2- Identify and monitor equipment operation in a freezer storage environment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying and reporting effects of freezing temperatures
- Monitoring equipment
- Identifying and reporting defects or mal-operation

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify and report effects of freezing temperatures
- Monitor equipment
- Identify and report defects or mal-operation

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
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Information Sheet 1- Identifying and reporting effects of freezing temperatures

Introduction

Freezing has been successfully employed for the long term preservation of many foods, providing a significantly extended shelf life. The process involves lowering the product temperature generally to -18 °C or below. The physical state of food material is changed when energy is removed by cooling below freezing temperature. The extreme cold simply retards the growth of microorganisms and slows down the chemical changes that affect quality or cause food to spoil.

1.1. Identifying and reporting effects of freezing temperatures

Exposure to elevated temperatures can be a serious contributing factor to quality loss in frozen foods. Generally, short periods of exposure are not serious, unless often repeated, but prolonged exposure can cause damage. However, for some particularly sensitive products, even a short exposure to temperatures warmer than 10-15 °F will result in marked loss in quality which will only become apparent after further storage. Temperature fluctuations should be avoided because they will cause migration of moisture from the product or within the package causing formation of ice crystals and partial dehydration of the product. In general, the product temperature is more important than the air temperature. A change in air temperature for a short period may not affect the product temperature significantly.

Refrigeration equipment used to transport frozen foods is designed to remove heat that may leak into the load compartment of the railcar, truck, or container. It should be noted that the refrigeration capacity does not provide for removal of much heat from the load. Therefore, if products are loaded with the temperature warmer than 0 °F (-18 °C), there is little or no opportunity for the product temperature to be reduced to the desired level during transit. Similarly, retail display equipment cannot be expected to remove significant heat from frozen foods. Therefore, it is imperative that frozen foods be at 0 °F (-18 °C), or colder, when they are loaded for transport or placed in retail cabinets.

Retail and institutional sized packages in standard shipping containers warm up rather rapidly when exposed to elevated temperatures and cool down slowly when placed in the ordinary still air of a storage room. For the duration of the warming up and the cooling down, quality losses are occurring even though the air temperature of the storage room is 0 °F (-18 °C).

The process of freezing is explained in figure 1

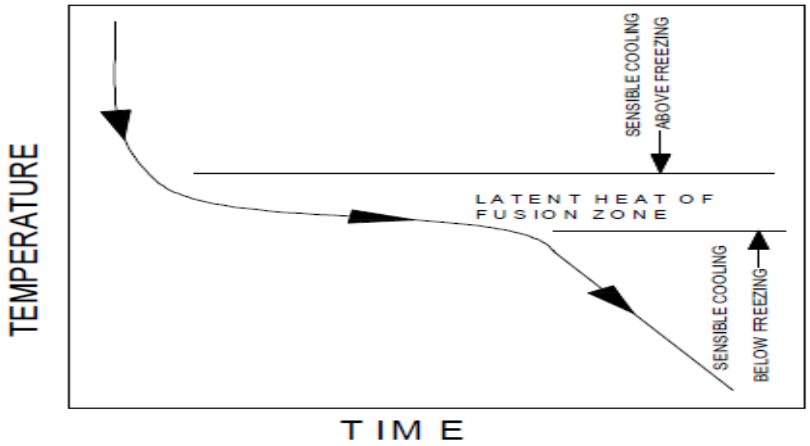

Figure shows the three phases of freezing:

- Cooling which removes sensible heat, reducing the temperature of the product to the freezing point.
- Removal of the product's latent heat of fusion, changing the water to ice crystals
- Continued cooling below the freezing point which removes more sensible heat reducing the temperature of the product to the desired or optimum frozen storage temperature.

It is essential to understand the following factors that govern the ultimate keeping quality and storage life of dairy produce:

- Composition of the product and its nature
- Selection, handling and preparation for freezing
- Freezing methods
- Storage conditions post freezing

The following advice is offered as a guide. Practice will vary somewhat with commodities and with other factors. It is important, however, that refrigerated warehouses and other handlers of frozen milk products have well defined policies in the matter of action following the taking of temperatures.

If the highest reading is 25°F (-3.9°C) or higher

Damage to quality is occurring rapidly and immediate steps should be taken to prevent further damage. Product should be placed in a blast freezer or equally rapid freezer with spacers between cases to permit air circulation and rapid temperature drop. Cases should not be removed to storage room or restacked until product is at 0°F (-18°C) or lower. Product which has been above 25°F (-3.9°C) should be evaluated after it has been returned to 0°F (-18°C) or below. It may no longer have acceptable quality. Even if quality is still acceptable, the remaining shelf life has been shortened.

If the highest reading is 10°F (-12°C) or higher, but below 25°F (-3.9°C)

Damage to quality is occurring slowly but at an unacceptable rate. To prevent further damage, it is necessary to place the product in 0°F (-18°C) or lower temperature within an hour. If this is not done, damage to quality can be expected. If the product has risen above 10°F (-12°C), air circulation should be provided between cases. Even if the quality is still acceptable, the life of product with readings above 10°F (-12°C) is significantly reduced. Steps should be taken to rotate this inventory quickly.

If the highest reading is 0°F (-18°C)

This temperature is satisfactory for most, but not all, products. Thus, for most products it can be assumed that the quality achieved after the initial freezing has been retained. Every effort possible should be made to protect that quality.

General Rule

If frozen milk products are at a desired low temperature, they may be stacked tightly to prevent air movement between cases to reduce the effects of a possible undesired increase in air temperature. If frozen foods are at an undesired high temperature that needs to be lowered without delay to preserve quality, cases should be stacked to allow

circulation of colder air between cases to hasten the lowering of product temperature. Other products should be protected during this procedure to avoid inadvertent warming by the product under treatment.

Time & Temperature Tolerance (TTT)

The integrated effects of time and temperature on frozen foods affect their color, flavor and texture, commonly referred to as quality. The degree to which individual products tolerate the time & temperature effects is called the Time-Temperature Tolerance (TTT). Regulations or company quality-assurance standards must specify and control both the time and temperature factors to guarantee product quality.

Critical Control Points (CCPs)

CCPs are vital steps in the process and are the ones that keep your customers and your business safe.

Freezing can preserve the taste, texture and nutritional value of foods better than most other preservation methods. However, such qualities depend upon the careful choice of food materials, use of appropriate pre-treatments, the choice of freezer and frozen storage options and the use of appropriate packaging.

The major considerations for optimum quality of frozen foods can be described under pre-freezing, freezing and post-freezing stages of manufacture.

1. Active chilling

Active chilling is when refrigeration is applied to remove heat from a warm product and reduce its temperature to one where most pathogens cannot grow.

Active chilling on-farm involves removal of heat from milk expressed warm from the udder at 38- 39°C and milk must be cooled to no warmer than 5°C within 3.5 hours from the start of milking and maintaining it no warmer than this.

Sometimes the temperature of milk will be warmer than 5°C when the tanker arrives for pick up. The decision whether to accept the milk is the responsibility of the processor and procedures.

Active chilling after pasteurization involves cooling milk from much higher temperatures either to storage (5°C or colder) or for immediate further processing, where the required temperature will vary according to the process.

2. Chill storage

The period of milk storage may vary up to 24 hours or more, depending on your processing schedule. The warmest temperature recommended for storage is 5°C, though from your hazard sheets you can see *L. monocytogenes* will grow steadily at this temperature, as will the spoiler, *Pseudomonas*.

Temperature control within chilled foods is most important from a food safety perspective. Abuse of temperature is likely to lead to increased occurrence and growth of pathogenic bacteria.

Table 1: Minimum growth temperatures of some bacteria found in foods

Class	Bacteria species	Minimum growth temperature (^{o}C)
Mesophilic	Salmonella	5.1^{o}C to 8.7^{o}C
	Staphylococcus aurous	9.5^{o}C to 10.4^{o}C (for growth) 14.3^{o}C (for toxin production)
Psychrotrophic	Escherichia coli	7.1^{o}C
	Listeria monocytogenes	-0.1^{o}C to +1.2^{o}C
	Yersinia enterocolitica	-0.9^{o}C to –1.3^{o}C
	Aeromonas hydrophilia	-0.1^{o}C to +1.2^{o}C

It should be noted that chilled dairy products are easily temperature abused in comparison with frozen foods as the temperature of the former can rise quickly. The ice in the latter 'protects' them in safety terms and from quality loss for brief periods at less-than-ideal temperatures. Awareness of the need for temperature control at all stages in

the chill chain and for a low initial bacteria count (e.g. less than 10^3 per gram) is of paramount importance to all involved with the handling of chilled foods – including the consumer.

Advantages of quick freezing over slow freezing

- Ice crystal formation is much smaller in quick frozen products and mouth feel is far better.
- Quick freezing takes much less time and hence salt diffusion from the product is far lesser and separation of water from the tissue is minimal.
- Product is quickly cooled below the TDZ (Temperature danger Zone) so that there is minimal chance of bacteria, yeast growth.

For best quality, refreeze food quickly. The faster food freezes, the smaller the ice crystals that form within the food. When food freezes slowly, larger ice crystals develop and cause the food to be mushier and to lose more flavor, nutrients and color.

If your freezer is full of thawed food, it will not refreeze quickly. Therefore, you'll probably need to take the food to a locker plant to have it frozen quickly before moving it back to your home freezer. If a locker plant is unavailable, a neighbor may have space to refreeze a portion of your food.

Self check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4pts)

1. The purpose of milk product freezing is to:
   A. Kills pathogens
   B. Break down milk fat
   C. Prevent spoilage
   D. Add vitamins
2. What the Advantages of quick freezing over slow freezing?
   A. Ice crystal formation is much smaller
   B. Product is quickly cooled below the Temperature danger Zone
   C. Quick freezing takes much less time
   D. all
3. Which one of the following is true about freezing?
   A. Freezing can preserve the taste, texture and nutritional value of foods better than most other preservation methods.
   B. The faster food freezes, the smaller the ice crystals that form within the food.
   C. When food freezes slowly, larger ice crystals develop and cause the food to be mushier and to lose more flavor, nutrients and color.
   D. All

Test II: write short answers (6pts)

1. What is the effect of temperature on dairy products, If the highest reading is 25°F (-3.9°C) or higher?

Note: **Satisfactory rating - 5points** **Unsatisfactory - below 5 points**

Information sheet 2 - Monitoring equipment

2.1. Monitoring equipment

Frozen system selection and operating

It is very important to set the correct temperature for storing food in the appliance. Micro-organisms will cause food which is not stored at the correct temperature to deteriorate rapidly.

Temperature influences the growth rate of these micro-organisms. Reducing the temperature reduces their growth rate.

The temperature in the appliance will rise:

- The more often the door is opened and the longer it is kept open,
- The more food that is stored in it,
- The warmer the food is which is being put into it,
- The higher the ambient temperature surrounding the appliance. The appliance is designed for use in specific ambient temperatures (climate ranges). Do not used in ambient temperatures for which it is not designed.

In the chilling room

We recommend a temperature of **4 °C** in the refrigerator section.

Dynamic cooling

The dynamic cooling fan switches on automatically when the cooling system for the refrigerator switches on. It distributes the temperature in the appliance to all areas more evenly so that all the food will be chilled to about the same degree.

In the freezer room

To freeze fresh food and to store frozen food for a long time, a temperature of **-**18 °C and below is required. At this temperature the growth of micro-organisms is generally halted. As soon as the temperature rises above -10°C, the micro-organisms become active in the food again so that it cannot be kept as long. For this reason, partially defrosted or defrosted food must not be re-frozen.

Food may be re-frozen once it has been cooked, as the high temperatures achieved when cooking destroy most micro-organisms.

Temperature display

The temperature display on the control panel always shows the required temperature.

The temperature display will flash if a different temperature is being set.

If the temperature in the freezer section is not within the range that the appliance is able to display, bars will flash in the freezer section temperature display.

The required temperature will also flash in the freezer section temperature display if the temperature in the freezer section has risen by several degrees, to show that there has been a loss of coldness.

This loss of coldness is no cause for concern in the following circumstances:

- When the door has been left open for a while, e.g. for removing or storing a large amount of food,
- When fresh food is being frozen.

However, if the temperature in the freezer section remains above -18 °C for a long time, check that the frozen food has not started to defrost. If it has, check that the food is safe to use and if it is, then use it as soon as possible.

Temperature alarm

An alarm will sound if the temperature in the freezer section becomes too warm. The temperature display and the alarm symbol ⚠ will also flash.

The temperature the appliance is set at determines the temperature the appliance recognizes as being too warm.

For example, the alarm may sound and the temperature display and the Alarm symbol ⚠ may flash,

- When freezing large amounts of food at once,
- When freezing fresh food which is still warm,
- If a lot of room air enters the freezer section when food is being loaded, re-arranged or taken out,
- In the event of a power cut,
- If the appliance has a fault.

The alarm will stop and the Alarm symbol  will go out when the temperature reaches the correct level again.

However, if the temperature in the freezer section remains above -18 °C for a long time, check that the frozen food has not started to defrost. If it has, check that it is still safe to use, and if so, use it as quickly as possible. Defrosted food may only be re-frozen after it has been cooked.

Door alarm

The alarm will sound if a door is left open for more than 60 seconds.

The alarm will stop as soon as the door is closed.

Switching the alarm off early

If the noise disturbs you, you can switch the alarm off early if you wish.

Loading / unloading docks

Used for in loading of products to be stored as well as out loading the refrigerated products from and to delivery trucks. They should be as spacious as possible because of the high activity levels. They should also be well lit and temperature controlled to about 5°C. The loading dock acts as a buffer between the temperatures controlled areas and the ambient.

Packaging Materials of Frozen Foods

Packaging materials of frozen foods impose special requirements. Selection of these materials should include consideration of their intended product use and storage period. These materials should resist water vapor permeability from condensation occurring as a result of frozen food surfaces being affected by colder surfaces in freezers and storage rooms. These packaging materials should be strong, have a degree of flexibility, or should not be completely filled. Materials also should protect against light and air

penetration. Vacuum packaging or gas flushing were when chosen, act to retard deterioration of certain products.

Thermometer – Dial or digital read-out instruments used to measure temperature; glass- and mercury-based thermometers must not be used in processing facilities. Thermometers must be routinely calibrated to ensure accuracy. May be used to monitor a process of heating or cooling which is essential for control of microorganisms. Your job may or may not require you to use a thermometer.

Utensils – Hand tools and/or hand-held containers such as pails, strainer, scoop, stirring paddles and sanitary shovels.

Brushes – A variety of brushes designed to assist you in proper cleaning of the equipment and areas assigned to you should be provided. Use each brush only for its intended function. In some cases, brushes may be color-coded; floor drain brushes should be a different color from equipment brushes.

Clean in place (C.I.P.) circulating a soap or detergent solution through pipelines and large equipment uses a system of pumps and sprays to automatically clean these systems. Some handwork and manual cleaning is required.

Clean out of place (**C.O.P.**) Cleaning of equipment, typically after dismantling, either manually (appropriate brushes) and/or mechanically in “COP” tank or sink designed to circulate hot soapy water by a pump mounted on the tank base or by rapidly bubbling air through the water. Parts must be rinsed prior to being placed in a C.O.P. tank. Manual/hand cleaning may be required first for some parts prior to placing in a C.O.P. tank.

Cleaner – Soap or detergent that breaks down and loosens soils so they can be rinsed away.

Self check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4pts)

1. Which one is true about micro-organism?
   A. Temperature influences the growth rate of the micro-organisms.
   B. Reducing the temperature increases their growth rate.
   C. Abuse of temperature is likely to lead to decrease occurrence and growth of pathogenic bacteria.
   D. All
2. When the alarm may sound and the temperature display and the Alarm symbol may flash?
   A. When freezing large amounts of food at once,
   B. When freezing fresh food which is still warm,
   C. In the event of a power cut,
   D. If the appliance has a fault.
   E. All
3. Which one of the following is the device used to measure the temperature of frozen product?
   A. Thermometer
   B. Hygrometer
   C. PH meter
4. The loss of coldness is no cause for concern in the following circumstances?
   A. for removing or storing a large amount of food
   B. When fresh food is being frozen
   C. When the door has been left open for a while
   D. All

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Information sheet 3- Identifying and reporting defects or mal-operation

3.1. Identifying and reporting defects or mal-operation

Freeze damage occurs by a number of mechanisms that results in loss of quality in a product after thawing. Loss of quality may be seen in the frozen product, e.g. freezer burn, discoloration, mechanical damage, but in many cases the loss of quality is not noticeable until after thawing and cooking. Most of the mechanisms of quality loss are determined by storage temperature and are accelerated with time spent above the recommended value. They are also promoted by temperature fluctuations.

Ice and water can damage food materials in many ways, including

- Unfrozen water - Even below –18^{o}C, up to 10% water can be unfrozen and take part in physical and biochemical reactions.
- Freezing damage – the expansion of water as it turns to ice can cause structural damage to the food. This is often the cause of large voids and excessive drip loss in frozen materials after thawing. The effect can be minimized by freezing rapidly and maintaining low and consistent temperatures during frozen storage.
- 'Ostwald ripening' – this is the tendency for large ice crystals to grow at the expense of smaller ice crystals. The effect is to induce freezing damage. It can be minimized by maintaining low and consistent storage temperatures.
- Accretion – the joining together of two adjacent ice crystals, leading to increased ice crystal size and freezing damage. Again, it can be minimized by maintaining low and consistent storage temperatures.
- Vapor migration – this is most apparent on the surface of frozen foods as the buildup of ice on the interior of packaging and on food surfaces. If unchecked, this can lead to freezer burn and associated changes in color and texture. It is caused by temperature gradients between the surface and centre of the product and can be minimized by maintaining low and consistent storage temperatures.
- Solute concentration and osmotic dehydration – during ice formation, the concentration of solutes in the unfrozen water increases, leading to inconsistency throughout the product and damage to the cell membranes. Also water and solutes

can leach out of cellular structures, causing loss of torpor and internal damage. These effects can be minimized by low storage temperatures.

Manufacturers and producers must include in product documentation a contact person for Cold Chain queries and notifications, and can also indicate in the documentation what initial measures can be taken if the Cold Chain is broken to minimize any further damage to the products.

Cold Chain businesses must educate their staff of the importance of notifications, and have in place procedures to encourage notifications (e.g. by making it clear that notifications are treated positively and that job security is not threatened by notifications).

Actions

If any break in the Cold Chain conditions takes place, the person or people detecting the break must –

- Notify their business owner of the nature of the break in Cold Chain conditions (i.e. whether it is a break of the never warmer than and/or of the maximum "out of refrigeration" time limit rule) and any circumstances relating to the break;
- Notify, or arrange for someone else to notify, the manufacturer or producer of the nature of the break and any circumstances relating to the break;
- Take the action, if any, specified in the product documentation for the break in conditions; and
- Take such further action, if any, communicated by the business owner or by the manufacturer or producer.
- Make a record of –
    - ✓ the nature of the break in Cold Chain conditions and any circumstances relating to the break;
    - ✓ The time and date of notifications to the business owner and the manufacturer (including the name of the person contacted and the person making the contact); and

- ✓ What action was taken, when and by whom, and who was consulted or authorized actions?

Holding Action

If there are no specific instructions in relation to a break in Cold Chain conditions, the following actions should be taken -

- Separate out the affected products and return them to a refrigerated area or freezer according to the product's never warmer than rule as soon as possible;
- Mark the containers and attach a visible sign stating "do not move or use: awaiting instructions".

Always be alert for things that might cause product contamination emergencies. Examples are: inadequate pasteurization; post pasteurization contamination; spoiled or contaminated food; broken equipment such as refrigeration failure; suspicious people or activities and anything else that may threaten your product or your facility. Immediately report such items to your supervisor.

Personal health & hygiene: If you begin feeling ill, have diarrhea, nausea, stomach cramps, or fever, you are obligated to immediately report this to your supervisor.

Personnel must report such health conditions to their supervisors**.** Personnel are responsible for personal cleanliness and hygiene practices to prevent contamination and cross-contact

Any person who, by medical examination or supervisory observation, is shown to have, or appear to have, an illness, open lesion, including boils, sores, or infected wounds, or any other abnormal source of microbial contamination by which there is a reasonable possibility of food, food-contact surfaces, or food packaging materials becoming contaminated.

Self check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4pts)

1. What kind of quality loss may be seen in the frozen product due to mal-operation?
   A. freezer burn
   B. discoloration
   C. mechanical damage
   D. all
2. _____is the tendency for large ice crystals to grow at the expense of smaller ice crystals.
   A. Ostwald ripening
   B. Unfrozen water
   C. Vapor migration
   D. Accretion
   E. Freezing damage

Test two

Write short answers (5 pts)

1. If there are no specific instructions in relation to a break in Cold Chain conditions, what actions should be taken?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

LG #58	LO #2- Handle frozen product safely

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying handling requirements for frozen product
- Handling frozen product
- Conducting work

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify handling requirements for frozen product
- Handle frozen product
- Conduct work

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Identifying handling requirements for frozen product

1.1. Identifying handling requirements for frozen product

General legislative directives relevant to frozen operations include:

- The Food Safety Act
  - ✓ covering descriptions of safety, quality, description offences, defense and enforcement and penalties
- Compositional Standards
  - ✓ covering specific product categories, e.g. quick-frozen foods, milk and dairy products, ETC
- Labeling, presentation and advertising
  - ✓ Covering nutritional declarations, ingredient declarations, minimum durability, e.g. 'best-before', 'use-by' dates.
- Additives and contaminants
  - ✓ e.g. colors and sweeteners, pesticides and residues, metals
- Packaging directives
  - ✓ e.g. 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.

Freezing has been successfully employed for the long term preservation of many foods, providing a significantly extended shelf life. The process involves lowering the product temperature generally to -18 °C or below. The physical state of food material is changed when energy is removed by cooling below freezing temperature. The extreme cold simply retards the growth of microorganisms and slows down the chemical changes that affect quality or cause food to spoil.

For any specific frozen product, which mode determines its shelf life, depends on the product characteristics (raw materials, ingredients, formulation), pre-freezing treatment, freezing process, packaging film and processes, and of course storage conditions. All of the quality deterioration and potential hazards are usually exaggerated or complicated

by a fluctuating time-temperature environment (e.g. freeze/thaw cycle) during storage. On the other hand, the shelf life of a frozen food can be extended through ingredient selection, process modification and change of package or storage conditions.

Deterioration modes of frozen dairy products (ice cream, yogurt, etc.)

- Iciness (re-crystallization of ice crystals)
- Sandiness (lactose crystallization)
- Loss of flavor
- Disruption of emulsion system

Temperature control is not the only factor that influences the safety of foods throughout its journey along the continuum. Each sector, from manufacturer, warehouse, distributor, transporter to retailer, is charged with the responsibility of adhering to and using proper handling techniques. These are comprised of codes of practice, good manufacturing practices, codes of hygiene, and acceptable industry practices where no legislation exists.

It should be noted that chilled foods are easily temperature abused in comparison with frozen foods as the temperature of the former can rise quickly. The ice in the latter 'protects' them in safety terms and from quality loss for brief periods at less-than-ideal temperatures. Awareness of the need for temperature control at all stages in the chill chain and for a low initial bacteria count (e.g. less than 103 per gram) is of paramount importance to all involved with the handling of chilled foods – including the consumer.

Freeze damage occurs by a number of mechanisms that results in loss of quality in a product after thawing. Loss of quality may be seen in the frozen product, e.g. freezer burn, discoloration, mechanical damage, but in many cases the loss of quality is not noticeable until after thawing and cooking. Most of the mechanisms of quality loss are determined by storage temperature and are accelerated with time spent above the recommended value. They are also promoted by temperature fluctuations.

Ice and water can damage food materials in many ways, including

- Unfrozen water. Even below –18^{o}C, up to 10% water can be unfrozen and take part in physical and biochemical reactions.
- Freezing damage – the expansion of water as it turns to ice can cause structural damage to the food. This is often the cause of large voids and excessive drip loss in frozen materials after thawing. The effect can be minimized by freezing rapidly and maintaining low and consistent temperatures during frozen storage.
- Ostwald ripening' – this is the tendency for large ice crystals to grow at the expense of smaller ice crystals. The effect is to induce freezing damage. It can be minimized by maintaining low and consistent storage temperatures.
- Accretion – the joining together of two adjacent ice crystals, leading to increased ice crystal size and freezing damage. Again, it can be minimized by maintaining low and consistent storage temperatures.
- Vapor migration – this is most apparent on the surface of frozen foods as the buildup of ice on the interior of packaging and on food surfaces. If unchecked, this can lead to freezer burn and associated changes in color and texture. It is caused by temperature gradients between the surface and centre of the product and can be minimized by maintaining low and consistent storage temperatures.
- Solute concentration and osmotic dehydration – during ice formation, the concentration of solutes in the unfrozen water increases, leading to inconsistency throughout the product and damage to the cell membranes. Also water and solutes can leach out of cellular structures, causing loss of turgor and internal damage. These effects can be minimized by low storage temperatures.

Self **check 1**	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (4pts)

1. What is Deterioration mode of frozen dairy products?
   A. Iciness (re-crystallization of ice crystals)
   B. Sandiness (lactose crystallization)
   C. Loss of flavor
   D. Disruption of emulsion system
   E. All
2. Ice and water can damage food materials in what ways?
   A. Even below –18^{o}C, up to 10% water can be unfrozen and take part in physical and biochemical reactions
   B. The expansion of water as it turns to ice can cause structural damage to the food.
   C. the joining together of two adjacent ice crystals, leading to increased ice crystal size and freezing damage
   D. All

Teat II: write short answers (5pts)

1. List the General legislative directives relevant to frozen operations?

Note: **Satisfactory rating - 4 points** **Unsatisfactory – below -4 points**

Information sheet 2 - Handling frozen product

2.1. Handling frozen product

General Instructions – For All dairy Products:

- Always clean and sanitize all product contact surfaces:
  - ✓ At intervals determined by the company.
  - ✓ After final use each work day.
  - ✓ Keep scouring pads clean and stored in sanitizer solution or hung up to dry (ideally scouring pads should be single service items). Replace sanitizer solution as needed to keep proper strength (use test strips or other testing as provided).
- Paper towels must be held by a dispenser.
- Wear disposable gloves where possible when hand contact is necessary. Clean hands and/or clean intact gloves are a must.
- Keep product preparation area free of clutter. Clean, sanitize and put away equipment not being used. Store equipment so it will stay clean and sanitary.
- Wash hands and change gloves frequently, and always when leaving and returning to the work area, handling unsanitary objects or after personal activities as mentioned previously (i.e., sneezing, scratching face, using the bathroom).
- Use sanitary hand-dip or hand-wash stations when they are provided.
- Clean and sanitize utensils and other food contact items when they fall to the floor before reuse.
- Pick up and handle utensils only by the handles.
- Use a suitable, clean utensil to remove any utensil that falls into the product.
- Discard single-service items after one use.
- Hold packaging and single-service supplies, stocked at work stations, off the floor, on shelving or clean plastic pallets or racks. Limit to a one-day supply.
- Break out from storage only the amount of ingredients needed.
- Ensure products are not stored in the temperature danger zone (40°F/4.4°C to 140°F/62.8°C) any longer than necessary to prepare them.

- Do not taste products with any utensil used to prepare foods? Use single service plastic spoon. Do not use fingers to sample product. Tasting product as needed should only be done for authorized evaluations in authorized areas.
- Do not reuse pipes, caps, utensils that have been exposed to milk or milk products until they have been properly washed and sanitized.

General Instructions storage of product, ingredients & supplies

I. Refrigerated and frozen items:

- In an orderly manner, at least six inches off the floor, on clean shelves, dollies, racks, or pallets and ideally at least 18 inches away from walls and equipment.
- Arranged in the proper order for first in, first out (FIFO) item rotation. Place newest items at bottom or back of older items.
- In a manner to avoid cross-contamination. Items that might leak or drip must be stored below other items.
- In a manner that prevents allergen cross-contact if allergenic ingredients are used that may contaminate ingredients, products or packaging that do not contain the allergen. Separate, well-labeled storage areas are required.
- In clean, covered, labeled containers if they have been removed from their original container
- Identify the hazards associated with storing your finished product.
- Make sure finished products are stored and handled under the proper conditions to prevent deterioration (such as spoilage) and damage (such as crushing or forklift damage).
- If the finished products need refrigeration, store them between 1°C and 4°C. Store frozen products at -18°C or less. Monitor storage room temperatures regularly.
- If products that need refrigeration were not packaged between 1°C and 4°C, arrange them on skids or shelving when placing them in the refrigeration unit in a way that lets enough air flow around the products to cool them to storage temperature as quickly as possible.

- Store materials that are sensitive to humidity under humidity-controlled conditions.
- Pay special attention to the temperature when your refrigeration units are defrosting. Don't overload their cold storage capacity.
- Make sure condensate pipes empty into a drain to reduce contamination.
- Keep refrigeration units including their condensate collection trays and drain lines clean and maintained on a regular schedule to prevent the growth of mold, spoilage bacteria and pathogens.
- Treat condensate trays with sanitizer to prevent the growth of harmful bacteria that could cross-contaminate employees' clothing or skin or other areas of your plant and eventually food products.
- If products can be stored at room temperature, protect them against contamination and conditions that could affect their safety or quality. This includes:
    - ✓ direct sun
    - ✓ excessive heating
    - ✓ moisture
    - ✓ external contaminants
    - ✓ rapid temperature changes that could affect the integrity of the product container or the safety or quality of the product
- Be careful about stacking dairy products. Clearly identify each container, and make sure the stack of containers won't fall over. Make sure they are protected from pests, moisture and too much weight.
- To make cleaning easy and to control pests, store items a suitable distance from the walls and off the floor. If you are storing products for more than one month, put them on pallets approximately 45 cm (18 in.) from the wall.
- If you are storing other food products in a finished product storage room, make sure they will not contaminate the dairy products or ingredients. Stack food products on pallets or shelves in a neat and well-organized way.
- Do not store eggs in finished product storage rooms. Eggs may contain pathogens that could cross-contaminate your products.

- Do not store any other products in finished product storage rooms that may transmit odors or flavors.

Do not store:

- Under possible sources of contamination, such as sewer lines, water lines or refrigeration lines, where there is accumulated condensation or evidence of leakage.
- In toilet rooms, vestibules, garbage rooms, salvage areas or mechanical equipment rooms.
- Directly on the floor or against a wall.
- In overcrowded conditions.
- Under conditions that allow refrigerated items to exceed 40° F (4.4°C)* or for frozen items to exceed 0°F (-17.8°C).

II. Dry Storage

- Keep ingredient containers sealed until used. When using only a portion of a bag or container of an ingredient, close the bag or container securely or transfer contents of opened bags or boxes of ingredients to clean, sanitized and dried covered, labeled, approved plastic or metal containers.
- Frequently check critical products for signs of pest infestation. Insects may be tiny and difficult to see. Critical products are all dairy-based powders, nuts, dry sugars, flavoring ingredients.
- Leave a space of at least 18 inches between stacks of product and between stacks and walls if storage is for more than 30 days, and observe the “white line.”
- Store all clean utensils, packaging, and single-service supplies under the same sanitary conditions as for ingredients. Again, check all partial packages of either packaging materials or ingredients to be sure they are properly sealed.
- Do not store cleaners and sanitizers above or close to ingredients, packaging supplies, single service items, or product contact items. Cleaners and sanitizers should be stored in a separate location from production, properly labeled.
- Store insecticides and other toxics in a separate area locked away from cleaners and sanitizers. Do not store them above or close to ingredients, packaging

supplies, single-service items, or product contact items. These areas need to be properly ventilated.

Dairy products must be stored in the refrigerator at temperatures of 2°C to 4°C (36° to 39°F). Follow these guidelines:

- The fat in dairy products has a tendency to absorb strong odors from the storage surroundings. To reduce the likelihood of this happening, store dairy products in their own area in protective coverings.
- Do not store dairy products in a vegetable cooler; a separate refrigerator is much more acceptable.
- Keep the refrigerator clean at all times.
- Rotate dairy products when fresh product arrives. Dairy products should not be ordered too far in advance of when they will be used. Ideally, such products should be delivered on a daily basis.

Frozen food must be kept at –18°C or lower to maintain its quality.

Keep these factors in mind when storing frozen foods:

- All freezer products not properly wrapped will develop freezer burn, which are a loss of moisture that affects both the texture and the flavor of the food. A common sign of freezer burn is a white or grey dry spot developing on the surface of the frozen product. Meat is particularly susceptible to freezer burn.

Controlled Temperature Storage

- Frozen items (0°F/-17.8°C or below). Check freezer temperature frequently – at least twice daily. If frozen ingredients must be thawed before use, do so in a manner that does not allow temperatures to increase above 40°F (4.4°C)*.
- Refrigerated items (40°F/4.4°C or below*). Check refrigeration temperature frequently – at least twice daily.
    - Microbial-derived hurdles
    - Competitive flora within the food micro-environment.

- Starter cultures.
- bacteriocins

There are major attractions with the freshness, quality, safety and convenience of chilled foods. Increased sophistication of the chilled foods industry has led to many breakthroughs in chilled food technology, but diligent controls is needed at all times. These include microbiological safety, extended quality shelf life, temperature control, and the retention of nutrients.

Two principles dominate control of quality and safety in chilled foods: PPP (product-process-package) and TTT (time-temperature tolerance).

Generally, quality cannot be gained from processing, but it certainly can be lost. High quality chilled foods require high quality raw materials and ingredients. The product development team needs to consider the interaction between ingredients and components of formulated foods. The PPP factors are:

Product

- Raw milk quality.
- Quality and suitability of ingredients, including additives/enhancers.
- Product formulation – how the component parts integrate to form the final chilled food product.

Process

- The speed and effectiveness of the chilling operation.
- The use of additional processes, e.g. heating, pasteurization.

Package

- Ordinary packaging, offering physical, chemical and barriers.
- Advanced packaging, including Modified Atmosphere Packaging.

Different dairy products requires different ranges of temperature for storage

Fluid milk

The shelf-life of fluid milk stored in the refrigerator (<4°F) will range from 8 to 20 days depending upon the date of manufacture and storage conditions in the grocers' shelf. Milk is a very nutritious and highly perishable food. Milk should never be left at room temperature and always capped or closed during refrigerator storage. Freezing milk is not recommended, since the thawed milk easily separates and is susceptible to development of off-flavors.

Dry milk

Dry milk may be stored at cool temperatures (10°C to 16°C) in airtight containers for one year. Opened containers of dry milk, especially whole milk products, should be stored at cold temperatures to reduce off-flavors. Handle reconstituted milk like fluid milk and store at refrigeration temperatures if not immediately used.

Canned evaporated milk and sweetened condensed milk

Canned evaporated milk and sweetened condensed milk may be stored at room temperature for 12 to 23 months. Refrigerate opened canned milk and consume within 8 to 20 days.

Cheese

Natural and processed cheese should be kept tightly packaged in moisture-resistant wrappers and stored below 4°C. Surface mold growth on hard natural cheese may be removed with a clean knife and discarded. Rewrap cheese to prevent moisture loss. Presence of mold growth in processed cheese, semi-soft cheese, and cottage cheese is an indicator of spoilage and thus these foods should be discarded.

Ice cream

Store commercial ice cream at temperatures below -18°C. Expected shelf-life of commercial ice cream is approximately 2 months before quality diminishes. Immediately return opened ice cream to the freezer to prevent loss of moisture and development of ice crystals. Store ice cream at constant freezer temperatures to slow growth of ice crystals.

A useful step in processing of chilled foods is the use of 'hurdle technology'. Hurdles are cumulative steps, each of which has the effect of reducing microorganisms within the food. Well-known hurdles are:

- Physical hurdles.
- Heat (e.g. blanching, pasteurizing, canning).
- Cold (e.g. chilling and freezing)
- Packaging (e.g. vacuum, aseptic, MAP)
- Physico-chemical hurdles
- Salt, sugar, dehydration, water activity
- Acidity (acidulants, fermentation)
- Sulfur dioxide, smoke, gases, ethanol
- Chlorine

In summary, the following factors are important in relation to achieving the necessary temperature control for chilled foods:

In chilled food production and storage:

- Use product temperatures as 'critical control points' in the HACCP plan.

In chilled food distribution:

- Prior cooling of the distribution vehicle is necessary to achieve the appropriate temperature during the entire distribution process.
- Product and environment temperatures should be closely monitored and recorded during the distribution process. Systems available include data loggers (both in-situ and portable).
- Time-temperature indicators (TTIs) are an emerging technology for food product monitoring:

- **In chilled food retail display**:
  - Introducing warm products into chilled food cabinets can cause a general temperature increase: it should be noted that cabinets are intended only for holding and are not designed for cooling foods.

- Poor cabinet stocking and stacking arrangements and inadequate servicing can cause significant problems with maintaining low temperatures.
- Iced-up cooling coils in cabinets indicate the need for proper defrosting regimes and correct setting of thermostats.
- Interference with cabinet design can disrupt the flow of cool air through the cabinet and cause a rise in temperature.

Product Returns

Finished products may be returned to your plant for several reasons. These include:

- expired shelf life
- customer complaints
- company product withdrawals
- recalls

These products may contaminate your plant environment, your equipment or other dairy products in your plant. Finished products that have left your direct control must not be salvaged and may not be used for processing or rework.

Shelf check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (7pts)

1. White spots in frozen products are a sign of_____?

A. use by date

B. freezer burn

C. Freshness

D. All

2. **Storing unused cheese in plastic wrap will:**

A. Prevent cheese bulging

B. Prevent transfer of smells

C. Cause the cheese to sweat

D. Extend the shelf life

3. Fluid milk should be stored at what temperature?

A. $4^{O}C$ or below

B. $-18^{O}C$ or below

C. $32^{O}C$ or below

D. $38^{O}C$ or below

4. Ice cream should be stored at what temperature?

A. $4^{O}C$ or below

B. $-18^{O}C$ or below

C. $32^{O}C$ or below

D. $38^{O}C$ or below

5. Finished products may be returned to your plant for what reasons?

A. expired shelf life

B. customer complaints

C. company product withdrawals

D. recalls

E. All

6. If products can be stored at room temperature, what is the condition that could affect their safety or quality?
   A. external contaminants
   B. excessive heating
   C. moisture
   D. direct sun
   E. All
7. When clean and sanitize all product contact surface is done?
   A. After final use each work day
   B. At intervals determined by the company
   C. No need of cleaning
   D. A &B

Test 2

Write short answers (6pts)

1. List Well-known hurdles which have the effect of reducing microorganisms within the food?

Note: **Satisfactory rating -7 points** **Unsatisfactory - below 7 points**

Information sheet 3 - Conducting work

3.1. Conducting work

Increasingly good temperature control is being achieved throughout the cold food chains as a result of improved equipment design, quality control and heightened awareness of issues surrounding food safety and quality. However, it is important to avoid complacency and to integrate temperature monitoring as a part of the Total Quality Management program.

Monitoring the cold chain requires detailed information on food product temperatures. Temperature monitoring includes both measurement and recording.

Defining the temperature monitoring system

- What is the required temperature range and likely operating temperature range for the instrument?
- Do we need to measure product temperatures? Ambient temperatures? Package temperatures?
- Do we need to measure or measure/record temperature?
- Do we need to measure time and temperature combination? What sampling frequency is required? Does the system need to provide a permanent record of temperatures?
- What is the required accuracy?
- What is the required response time?
- If electronic, does the battery life compromise the application?
- What shape of probe is required? A long flat probe to reach between packages?
- Is water proofing of the probe/electronics required?
- Can the temperature data be imported into commercial data analysis spreadsheets or software packages?
- Does the system allow ease of calibration?

Temperatures can be measured directly (contact with the food) or indirectly (measuring the environment or between packages). The common stages of investigation for temperature checks are:

- Inspect air temperature recorders and thermometers to ascertain the temperature history of the product.
- Visually check the product appearance, looking for signs of thawing. These may include: evidence of drip loss, ice on the inside of the package, soiled packaging.
- Undertake a non-destructive investigation by measuring the temperature between adjacent packages or boxes.
- Undertake measurements with a pre-cooled probe and ensure good surface contact. Ensure the probe has good thermal conductivity and a low heat mass.
- Apply sufficient pressure between the probe and the package to obtain a good measurement. The probes should be inserted to a depth sufficient to immerse completely the temperature-sensitive part of the probe, and also to minimize errors from heat conduction from other areas.
- The probe should be held in place for a time sufficient to obtain a steady, non-fluctuating indication of temperature. Measurements should be taken at several points if possible, moving quickly from one point to another.
- If any of the above tests indicate that temperatures are too high, an invasive test may be required.

Steps in taking temperatures

A method is described below involving either a dial thermometer with stem or a thermocouple (electrical devices for measuring temperature).

- Open top of case and remove top corner package.
- Make hole through the case from inside in line with the second layer of product. Use an ice pick or similar tool. Do not use the stem of the thermometer.
- Place the thermometer or thermocouple in the hole from the outside, so that the end of the stem, the sensing element, is about 3 inches (8 cm) in from the case wall. Make sure the sensing element is held firmly between packages.

- Place package back in its normal place and close top of case. Do steps 1 to 4 as quickly as possible.
- Place two or more cases on top to assure contact of stem with packages of product.
- Read temperature after 5 minutes.
- Check the accuracy of the thermometer or thermocouple regularly and keep a record of the checks and any recalibrations.

Good manufacturing practice intends to give the best guidance available on practical means of achieving and maintaining high quality chilled and frozen foods. There are key guidance points given for each stage of the operation:

Step 1: Raw materials and packaging

- Set product specifications, e.g. microbiological, temperature, quality, hygiene
- Adopt 'approved suppliers' and incoming product inspection regimes
- Comply with packaging directives, e.g. contact materials, environmental
- Ensure packaging meets technical requirements, e.g. barrier, insulation

Step 2: Control the manufacturing operation

- Use appropriate freezing equipment to maximize quality
- Pass through 'zone of crystallization' as quickly as possible
- Regard freezing as complete only when product reaches –18^{o}C throughout
- If manufacture requires heating, cool as soon and quickly as possible
- Ensure storage and transportation of chilled foods is below 4^{o}C High risk categories require special (segregated) manufacturing conditions

Step 3: Maintain the appropriate storage conditions

- Maintain primary and secondary freezer stores at between –20^{o}C to –28^{o}C
- Maintain frozen product temperatures at less than –18^{o}C
- Maintain chill stores at between 0^{o}C and 8^{o}C
- Maintain chilled products that spoil rapidly at between –1^{o}C and +2^{o}C
- Maintain microbiologically susceptible products at between 0^{o}C and +5^{o}C
- Minimize air temperature variations in cold stores
- Ensure optimum stacking patterns in storage regimes
- Monitor and record air temperatures in warmest part of the storage facility
- Provide alarms to indicate temperature abuse

A useful '**rule of thumb'** is the **never warmer than** rule for any point within the cold chain: -18^{o}C for frozen foods, +4^{o}C for chilled foods.

Food that is temperature abused will spoil rapidly as evidenced by off-odors, off-flavors, off-color, and/or soft texture. For instance, spoiled milk exhibits a fruity off-odor, acid taste, and may curdle.

Freezing

The freezing step can be accomplished in several ways. A common method is simply a variation of the basic Birdseye process: indirect contact with a refrigerant that flows through shelves or belts that may touch the bottom or both top and bottom of the packages, commonly called convection freezing.

An increasing quantity of foods is being frozen by a free flow freezing process to achieve individually quick frozen (IQF) product pieces. The unpackaged food is frozen either on belt freezers where air at -34°C blows up through a mesh belt and through a thin layer of small food product pieces or in fluidized-bed freezers where the blast of upcoming air is of sufficient velocity to partially suspend the food.

Cleaning & sanitizing product contact items

Follow prescribed standard operating procedures (SOPs) for cleaning and sanitizing all equipment. Inspect items for cleanliness and overall condition; repair and/or replace as needed.

A. Clean out of place (COP)Items — Require Disassembly and Manual or COP tank cleaning:

- Follow written SOPs for cleaning that generally includes:
  - ✓ Pre-rinse with warm water.
  - ✓ Wash with manual detergent solution, made as directed in hot (e.g., 125°F/51.7°C) water using appropriate brushes and brushing action or by placing parts in a COP tank with the appropriate detergent solution, made as directed in hot (e.g., 160°F/71.1°C) water. Ensure that COP tanks are not overcrowded and allows circulation action.
  - ✓ Rinse with cool water after wash.
  - ✓ Acid rinse if needed.
- Clean and sanitize smaller items such as valve and pump parts, gaskets and "O" rings, retainer rings, springs. Place these parts in a basket. Some parts you will be asked to leave in the sanitizer solution until reassembled into their places of use. The balance you will **drain and air dry**.
- Store cleaned and sanitized items where they will stay sanitary.
- C.O.P. tank or sink should be kept clean (manually cleaned as necessary).

B. **Large Items & Equipment**

- Remove all food, debris, and packaging and processing supplies from the work area.
- Breakdown all equipment for cleaning.
- Clean all food contact items as follows:
  - ✓ Drain or remove excessive, visible food soil
  - ✓ Rinse thoroughly with warm water
  - ✓ Soap and scrub with appropriate brush or cleaning pad
  - ✓ Rinse
  - ✓ Soap and scrub again as needed
  - ✓ Rinse

- ✓ Sanitize by spraying or pouring sanitizer solution over all surfaces.
- ✓ Dip small, removable parts in sanitizer solution. Do not rinse after sanitizing.

- Position all items so they will drain and dry completely. (Air dry.)
- Reassemble at beginning of next shift.
- Sanitize as necessary after reassembly.
- Apply food-grade mineral oil spray or gel lubricants only as necessary to protect equipment from sticking.

Note: Remember the purpose of cleaning is to deny the food and moisture necessary for germs to grow; re-examine the items you have cleaned to be sure they are clean and positioned to dry.

C. Machinery Surfaces and Frame Work

- Clean thoroughly with hot, soapy water. Use foam cleaners as applicable.
- Rinse immediately with warm, clean water.
- Apply sanitizer solution as appropriate.
- Air dry.

D. Mixing Instructions for Sanitizer Solution

Follow label directions. Do not use more sanitizer than called for by the directions.

E. Testing for Strength of Sanitizer Solution

Strength of sanitizer solutions should be confirmed after preparation. Save a sample in a container provided for by lab personnel. If you are assigned to check the solutions, test papers or kits will be supplied to you along with instructions for their use.

Cleaning and Removing Freezer Odors

If your freezer is full of warm, dripping or spoiled food, you need to take one or more of the following steps to clean and deodorize it before refilling it:

- Take out all removable parts and wash them with warm water and mild soap or detergent. Also, wash the gaskets and door liner. Rinse well and dry.

- Wash the interior walls with a solution of 2 tablespoons baking soda to 1 quart warm water.
- Pour baking soda onto large, flat pans and place pans on the freezer shelves to absorb odors.
- Spread activated charcoal onto large, flat pans and place on shelves inside the freezer. Leave the freezer empty and allow it to run at its highest temperature for a few days to allow odors to be absorbed. Activated charcoal usually is quite effective in absorbing odors and can sometimes be obtained at appliance stores.
- Place freshly ground coffee in small bowls inside the freezer and allow the freezer to run at its highest temperature for several days. Wash the inside of the freezer again to remove the slight coffee odor that will probably remain.
- Pack each freezer shelf with crumpled newspaper. Put a cup of water on the top shelf or sprinkle the newspaper lightly with water. Allow the freezer to run for approximately five to six days at its highest temperature.
- Get and follow manufacturer's directions for commercial products available for removal of refrigerator and freezer odors.

Housekeeping & pest control

I. Housekeeping

- Regularly remove dirt, dust, debris, insect or spider webbing, mold from floors, walls, cracks, fixtures and equipment.
- Use and store cleaning and maintenance materials so they cannot contaminate food, utensils, packaging supplies and food contact items.
- Hold recyclable materials and dispose of trash and garbage so they will not contaminate products or ingredients, attract pests, or contribute to insanitary conditions. (Suitable bins or containers for recyclable materials should be furnished by the company and positioned to prevent any chance of cross contamination.)

✓ Keep trash containers covered, clean, and in good repair.

- ✓ Empty containers when necessary to prevent overflowing or otherwise becoming a nuisance, or at least daily. DO NOT allow trash and garbage to accumulate at work stations or other places inside the facility.
- ✓ Do not allow outside trash and garbage storage to attract pests. Keep dumpsters tightly covered and locked if necessary.

I. Pest Control

- Keep outside doors and windows closed or screened. Report obvious gaps or openings that might allow pests to enter the facility.
- Inspect incoming ingredients and materials as well as delivery vehicles.
- Keep trash and garbage in covered, appropriate containers.
- Report any signs of pest activity to your supervisor, including actual pests, droppings, or damage.
- Keep exterior areas free from debris, standing water or other pest harborage sites.
- Cleanup and remove any signs of pest activity.
- Use and store pesticides so they do not contaminate product utensils, packaging supplies, contact items. Must be locked in a separate area.
- Only trained and licensed personnel shall apply pesticides.

General Regulatory inspections

- ✓ Officials who visit your facility to inspect your sanitation and food procedures may represent the federal, state, county, or city.
- ✓ Inspectors may legally inspect your facility at any reasonable time of day.

- **What to Do**
  - ✓ Be courteous.
  - ✓ Do not keep the inspector waiting.
  - ✓ Do not answer questions asked by the inspector. Instead, politely refer him/her to your supervisor. Do not volunteer information to the inspector.
  - ✓ Immediately take the inspector to your supervisor.

Self Check	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3pts)

1. What quality is deteriorated for food that is temperature abused?
   A. off-odors
   B. off-flavors
   C. off-color
   D. Off-soft texture
   E. All
2. Which one of the following is not true?
   A. Maintain frozen product temperatures at less than 18^oC
   B. Provide alarms to indicate temperature abuse
   C. Maintain chill stores at between 0^oC and 8^oC
   D. All
3. One is not true about cleaning
   A. Do not rinse after sanitizing.
   B. Use more sanitizer than called for by the directions.
   C. store cleaned and sanitized items where they will stay sanitary
   D. all

Test 2(6pts)

1. What are steps you have to use to clean and deodorize Freezer Odors before refilling?

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Operation Sheet 1– Measuring product temperatures

Measuring product temperatures

Use the following methods when taking product temperatures by using either a dial thermometer with stem or a thermocouple (electrical devices for measuring temperature):

1. Open top of case and remove top corner package.
2. Make hole through the case from inside in line with the second layer of product. Use an ice pick or similar tool. Do not use the stem of the thermometer.
3. Place the thermometer or thermocouple in the hole from the outside, so that the end of the stem, the sensing element, is about 3 inches (8 cm) in from the case wall. Make sure the sensing element is held firmly between packages.
4. Place package back in its normal place and close top of case. Do steps 1 to 4 as quickly as possible.
5. Place two or more cases on top to assure contact of stem with packages of product.
6. Read temperature after 5 minutes.
7. Check the accuracy of the thermometer or thermocouple regularly and keep a record of the checks and any recalibrations.

Lab test	Performance Test

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **30** minutes. The project is expected from each student to do it.

Task-1 Perform measuring product temperature
Task-2 Perform keeping a record of the checks and any recalibrations

LG #59	LO 4 - Respond to emergencies

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying signs and symptoms of exposure
- Taking appropriate action
- documenting and reporting constraints and action taken

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Identify signs and symptoms of exposure
- Take appropriate action
- document and report constraints and action taken

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1 - Identifying signs and symptoms of exposure

1.1. Identifying signs and symptoms of exposure

Anhydrous ammonia

What is anhydrous ammonia and why is it so dangerous?

Anhydrous ammonia, at room temperature, is a pungent, colorless and highly water-soluble gas that can be liquefied under pressure or by cooling to below its boiling point (-33.4^{o}C) at atmospheric pressure. Anhydrous ammonia (where anhydrous means 'without water') has a high affinity for water and is highly water soluble. When anhydrous ammonia is dissolved in water, it forms an alkaline solution of ammonium hydroxide leading to higher pH levels in the solution. Alkaline pH levels create the corrosive conditions that can cause extensive damage to moist areas, including the skin, and the mucous membranes of the eyes, nose, mouth and throat.

What are the health effects?

Exposure to anhydrous ammonia can have the following health effects:

- **Up to 100 parts per million (PPM)** – no adverse effect for the average worker with no deliberate exposure for long periods permitted
- **400 PPM** – immediate nose and throat irritation with no serious effect after 30 minutes to one hour
- **700 PPM** – immediate eye irritation with no serious effect after 30 minutes to one hour
- **1,700 PPM** – convulsive coughing; severe eye, nose and throat irritation; could be fatal after 30 minutes
- **2,000-5,000 PPM** – convulsive coughing, severe eye, nose, and throat irritation; could be fatal after 15 minutes
- **Over 5,000 PPM** – respiratory spasm, rapid asphyxia and fatal within minutes.

Anhydrous ammonia destroys delicate respiratory tissue in the lungs causing pulmonary and respiratory distress. The effect on the eye depends on whether a spray or gas is involved, and may range from mild irritation to eye destruction. Severe ammonia inhalation injury can be followed by a persistent asthma-like syndrome and airway hyper-responsiveness3. Moist and sweaty skin is prone to ammonia chemical burns. As an alkali, ammonia causes tissues to liquefy where anhydrous ammonia burns keep spreading until the chemical is diluted. As well as liquefaction, super cooled anhydrous ammonia spray causes a freeze-dry effect like frostbite when it hits skin and is also capable of freezing clothing to skin.

The extent of damage to human tissue will depend on the concentration and length of time of exposure to anhydrous ammonia.

What are the hazards from ammonia released into the air?

Liquefied ammonia released during an incident presents other hazards. For example, liquefied ammonia has an expansion ratio of approximately 850 to 1, which means that on release to ambient air, a given volume of liquefied ammonia will expand 850 times and could potentially cover an extensive area. Such a release will also involve an aerosol phase (i.e. small liquid droplets) along with ammonia gas. When released, it will be very cold and consequently behave as a dense gas (even though it is normally lighter than air) until it is warmed. One of the main characteristics of this cold dense gas behavior is that the vertical mixing is suppressed. This is due to a stable density layering effect, which generates a slowly diluting vapor cloud that hugs the ground. A release that travels along the ground rather than immediately rising into the air increases the risk of exposure to workers and others. Released ammonia will rapidly absorb moisture from air and will form a dense, visible white cloud at high concentrations.

Safety duties

Who has safety duties?

the person who has overall responsibility for the workplace with an ammonia-based refrigeration system has duties under the worker health and safety (WHS) Act for implementing safe systems of work including conducting a comprehensive hazard identification and risk assessment of the workplace to identify situations that will require planning for an emergency.

The process must look at the hazards presented by:

- Anhydrous ammonia and the various phases, including liquid and aerosol phases
- Associated plant and equipment, including storage and handling systems
- Related activities such as operation, maintenance, repair and decommissioning.

Specific emergency planning requirements exist under the Work Health and Safety Regulation 2011 (WHS Regulation).

Emergency procedures:

- For an effective response to an emergency
  - ✓ Evacuation procedures
  - ✓ Notifying emergency services
  - ✓ Medical treatment and assistance
  - ✓ Effective emergency communications within the workplace
- Testing of the emergency procedures and frequency of testing
- Information, training and instruction to relevant workers in relation to implementing the procedures

Additionally, it must maintain the plan so it remains effective. In developing the plan, it must have regarded to the:

- Nature of the work: examples include cold store room work, refrigeration system operation and maintenance, production processes in refrigerated environments
- Nature of the hazards: examples include chemical and physical hazards presented by toxic ammonia gas and liquid under pressure

- Size of the workplace, number and composition of the workers: for example, an abattoir operation; large food processing workforce within a refrigerated environment; a small crew operating an ice-works; a lone maintenance contractor working on a refrigeration system; a cleaning crew working after hours
- Location: for example in a refrigeration plant in close proximity to a residential neighborhood or in a relatively remote rural area some distance from support services such as contractors and emergency services.

Anhydrous ammonia is classified as a hazardous chemical under the WHS Regulation. This can be confirmed by referring to the manufacturer's safety data sheet (SDS). As a result, the requirements of class 7.1- Hazardous chemicals apply to the storage, handling and use of anhydrous ammonia. Particular sections that support emergency planning considerations include:

- First aid
- Personal protective equipment
- Remote or isolated work
- Managing risks from airborne contaminants
- Managing risks associated with a hazardous atmosphere
- Hazardous chemicals register
- Manifest for emergency services
- Placarding of storage and handling areas
- Elimination of ignition sources from a hazardous area
- Containing and managing spills
- Fire protection and firefighting equipment
- Emergency equipment
- Safety equipment
- Control of risks from the ammonia storage and handling systems in regard to operation, testing, and maintenance

Many of the refrigeration incidents occurred during maintenance and commissioning activities, the main cause being failure to isolate effectively. Other incidents were caused by plant failure, possibly linked to a lack of preventive maintenance. Other causes were:

- Corroded pipe work
- Failure of seals
- Failure of valves
- Blockages

Levels of emergency

Once the type of incident has been identified, the level (or scale) must be assessed. The level of escalation needed to manage an incident is best determined by the impact (consequence) it is expected to have:

- On the local work area
- Workplace-wide
- Both within and beyond the boundary of the workplace

Don't focus on just the worst case scenario. Many incidents start small. Provide a tiered set of responses. Procedures need to guide workers to make the correct assessment and to be looking out for potential escalation and the need to scale up the response.

It is important to clearly define the different levels of an emergency at a workplace. For example:

- A major leak, which could be dangerous to people outside the immediate work area such as the plant room, or occur in an occupied process area, would require the emergency management team to be assembled and attended by external emergency services.
- A minor leak, which is unlikely to affect anyone outside the immediate work area, may be dealt with by on-site personnel following the established safe work procedures.

There are a number of tools that can be used to assist in a more orderly response during ammonia incident, including:

- Electronic resources (system information and schematics, SDS)
- Technical expertise (on-site staff and external specialists)
- Gas detection equipment
- Mitigation equipment:
- Windsocks
- Water fogging equipment
- Neutralizing agents such as citric acid for liquid run-off or carbon dioxide for injection to reduce airborne ammonia concentrations
- Pipe repair equipment
- Product transfer equipment
- Suitable high expansion foam to cover liquid spills
- Portable ventilation fans to assist clearing residual gas
- Sand/soil to isolate and/or control the flow of contaminated water run-off
- Waste management equipment or arrangements
- Respiratory and skin protection
- Communication equipment

II. Extreme cold due to accidental lock in the cold store

Employees and others may suffer death or serious injury from prolonged exposure to cold temperatures if accidentally locked in the cold store.

When cooling affects the entire body, a problem known as **hypothermia**, or generalized cooling, develops. Exposure to cold reduces body heat. With time, the body is unable to maintain its proper core (internal) temperature. If this cooling is allowed to continue, hypothermia leads to death. Although specific temperatures are listed for particular signs and symptoms, there is some variation in the temperatures at which these events occur.

Diagram 1 Mechanisms of heat loss

Self check 1	Written test

Name…… ID……. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (3pts)

1. How the manager identify the hazards
   A. Walked around all the areas where the staff, contractors, customers and others may go,
   B. Talked to the two company first-aiders
   C. Talked through the issues with the safety representative
   D. All

1. When cooling affects the entire body, a problem known as _____?
   A. Hypothermia
   B. Plod pressure
   C. Anaerobia
   D. Anemia
2. One of the following is the mechanism of heat loss though exhalation of warm air and inhalation of cold air?
   A. Respiration
   B. Evaporation
   C. Conduction
   D. Radiation

Test 2write short answers (10pts)

1. What are the five steps the manager followed to assessment risk?
2. Alkaline pH levels create the corrosive conditions that can cause extensive damage to moist areas. What are those areas?

Note: **Satisfactory rating -7 points** **Unsatisfactory – below - 7 points**

Information sheet 2 - Taking appropriate action

2.1. Taking appropriate action

I. Accidental release expose to extreme cold temperature

For the hypothermic patient who is alert and responding appropriately, proceed with active re-warming:

- Remove all of the patient's wet clothing. Keep the patient dry, and dress the patient in dry clothing or wrap in dry, warm blankets. Keep the patient still, and handle him very gently. Do not allow the patient to walk or exert himself. Do not massage his extremities.
- During transport, actively re-warm the patient. Gently apply heat to the patient's body in the form of heat packs, hot water bottles, electric heating pads, warm air, radiated heat, and even your own body heat. Do not warm the patient too quickly. Rapid warming will circulate peripherally stagnated cold blood and rapidly cool the vital central areas of the body, possibly causing cardiac arrest. If transport is delayed, move the patient to a warm environment if at all possible.
- Provide care for shock. Provide oxygen, warmed and humidified if possible.
- Give the alert patient warm liquids at a slow rate. When warm fluids are given too quickly, the patient's circulation patterns change. Blood is sent away from the core and instead routed to the skin and extremities. Do not allow the patient to eat or drink stimulants.
- Except in the mildest of cases (shivering), transport the patient. Continue to provide high-concentration oxygen and monitor vital signs. Never allow a patient to remain in or return to a cold environment

What are you already doing?

- Access to the store restricted to authorized, trained persons only. 'No entry' signs clearly posted.
- Emergency exit provided, door fitted with strip heaters to ensure it does not freeze.
- Emergency lighting provided (mains powered, battery back-up).
- Daily check on emergency exit door to ensure it is not frozen shut.

- Emergency exit door instructions posted on illuminated board by exit.
- Two trapped worker alarms (battery operated, mains back-up) next to both exits.
- Supervisor ensures thorough check of building before it is locked.
- Alarms and emergency lighting regularly tested/maintained by competent person.
- Check instructions remain clearly visible.
- Periodic checks to ensure clear access to emergency exit maintained, and that door is operational.

II. **Accidental release of refrigerant (ammonia)**

Employees and others may suffer fatal respiratory irritation following exposure to ammonia. Exposure to even low concentrations can cause severe eye and throat irritation.

Emergency procedures

Emergency procedures must detail specific duties of all staff and the arrangements for:

- Evacuation
- Rescue
- First aid
- Resuscitation
- Plant isolation

During an emergency, people must have clear, simple, practical instructions to follow.

Emergency procedures need to be in place to deal with:

- On actuation of alarm, emergency team informed.
- Call out to specialist refrigeration contractor.
- Emergency team calls fire brigade.
- Establish wind direction and tailor evacuation plans accordingly. (wind sock)
- Emergency team will announce on the action to be taken.
- Ammonia alarm sounder must be different from fire alarm

- Call an ambulance if aware of injuries and ensure access available for emergency vehicles.
- Emergency team and specialist contractor must stand by to assist fire brigade
- Employees and visitors must only return to evacuated areas after being instructed to do by emergency support team or fire brigade.
- Detecting a gas escape, using both fixed-type and portable or hand-held type detectors
- Assessing the situation to provide initial information on type and scale of leak
- Containing releases
- Operating fire protection equipment
- Monitoring gas concentrations over time at various locations
- Emergency venting of plant (ventilation)
- Emergency shutdown processes
- Closing valves to isolate the system into smaller sections and to prevent further escape
- Equipment shutdown
- Dealing with power outages
- System start-up after an emergency shutdown
- Isolating electrical appliances where required
- Dealing with leaks of liquefied ammonia that may pool and/or flow
- Tables of the safe operating conditions for critical valves and components
- Diagram/s of the current as-fitted operating system showing integral parts and critical valves and their locations at the facility
- Safe work procedures to conduct anticipated emergency response actions
- Coordination with local emergency responders.
- Additional procedures will be required for out of hours

What are you already doing?

- Extraction and ventilation plant installed.
- System designed as per industry practice.

- Written scheme of examination for all refrigeration plant, including vapor detectors
- Only authorized persons allowed in plant room and room locked when not in use.
- Plant examined as per written scheme by a competent person.
- Plant maintained by a competent person.
- High-hazard maintenance jobs (e.g. oil draining) are identified and done by competent people, such as qualified refrigeration specialists, following safe systems of work and using the correct equipment.
- Staff trained in the risks of ammonia and its effect on health.
- Emergency plan for ammonia release agreed, including victim rescue policy and policy for neighboring properties, and discussed with local fire service.
- Staff trained in emergency plan.
- Vapor detectors near likely leakage points activate alarm and emergency extraction if workplace exposure limit (25 parts per million) reached.
- Water shower nearby for those exposed to an ammonia spray.
- Windsock to show wind direction in event of release

Use of contractors at a workplace

Safety duties at a workplace are neither transferrable nor able to be 'outsourced' to a contractor.

If a refrigeration contractor is engaged to undertake activities relating to the ammonia refrigeration system such as the operation, maintenance, testing and inspection.

The level of consultation will depend on the tasks to be undertaken at the workplace and agreements must be made on the:

- Use of resources and equipment
- Extent of the emergency response actions undertaken
- Provision of training

If a contractor is engaged to develop emergency plans relating to ammonia systems, they must be developed in consultation with the responsible for the system and include:

- Hazards identified for that particular workplace
- Subsequent risk assessments

Self check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (2pts)

1. **What are you already doing for extreme cold due to accidental lock in the cold store?**
    A. Emergency exit provided
    B. Emergency lighting provided
    C. Access to the store restricted to authorized, trained persons only. 'No entry' signs clearly posted
    D. All

Test 2(10pts)

1. When is it appropriate to treat a cold emergency with active re-warming, and when should you perform passive re-warming?
2. List five situations in which a patient may be suffering from hypothermia along with another, more obvious medical condition or injury.

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

Information sheet 3 - documenting and reporting constraints and action taken

3.1. Documenting and reporting constraints and action taken

The emergency planning process must be documented in the workplace's emergency plan. Suggested sections could be:

- Objectives and scope
- Contacts
- Activation and deactivation
- Organizational structure
- Emergency functions
- Roles and responsibilities of various personnel
- Emergency response approaches and procedures
- Protective actions
- Facility resources or resource acquisition arrangements – quantity/location and contacts
- Community engagement and media
- Facility map
- Plan testing and review
- Emergency assistance arrangement

It does not need to be as big as a phone book: avoid wordy overly complex presentation, use photos, diagrams and schematics instead of an over-reliance on text and include useful instructions on what to do rather than general information. Importantly, test the effectiveness of procedures in an exercise before they have to be used in a heightened or crisis situation.

Written safe work procedures for several basic facility operations, including removing oil from the refrigeration system and start-up procedures, must be developed. Post-incident investigations revealed these routine operations appear to have caused a significant number of the emergencies. Where procedures require closing specific valves, these should be marked and identified on the drawings and readily identifiable in the plant.

The way you record the checks should suit you and your staff. For instance it may not be practical to record the temperature every time you probe food. Instead decide on a frequency of recording checks that suits you. What is essential is that you record what actions you take when things go wrong, therefore if you decide to reduce the number of recorded checks it is recommended that you also establish a food safety diary or log book.

Although the work safety regulations do not specify what checks and how frequently they should be carried out or recorded, it is important that you as the person responsible for emergency have sufficient confidence in your system.

The risk assessment and control measure taken records should include the following:

- Date of the assessment
- Name of the assessor(s)
- Name of people who provided specialist advice
- The premises, storage location, area or process to which the record relates
- Types hazards
- The sources of information reviewed or used to make decisions
- Identified risks
- Controls necessary to reduce risks
- The existing controls in place
- Any controls that need to be introduced.

The record of the result of the assessment must be accessible to any person engaged to work at the premises who could be exposed to the risk, and to any relevant OHS representative (including the consultative process).

Self check 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer (2pts)

1. What is the emergency planning process must be documented in the workplace's emergency plan?

A. Protective actions

B. Organizational structure

C. Emergency functions

D. Roles and responsibilities of various personnel

E. All

Test II

Write short answers (5pts)

1. List the information during reporting of risk assessment and control measure taken?

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Answer key

LO one

Information sheet 1

Test one

1. C
2. B
3. B
4. D

Test two

- Jacket
- Salopettes
- Gloves
- Hard Hats
- Safety Shoes

Information sheet 2

Test one

1. E
2. C
3. C

Information sheet 3

Test I

1. C
2. A
3. A

Test two

- Work, if you are diagnosed with or have symptoms of or are a possible carrier of a communicable disease
- Carry any items in shirt pockets
- Wear fingernail polish, false fingernails, or excess makeup
- Wear strong cologne, perfume, or other products with strong odors.
- Pick, scratch, groom, or otherwise handle parts of your body while preparing and packaging the product.
- Spit, while in product-handling areas.

- Eat, drink, smoke, or chew (tobacco or gum) except in an authorized area.

LO two

Information sheet 1

Test one

1. C
2. D
3. D

Information sheet 1

Test one

1. **A**
2. **E**
3. **A**
4. **D**

Information sheet 1

Test one

1. **D**
2. **A**

Test two

- Separate out the affected products and return them to a refrigerated area or freezer according to the product's never warmer than rule as soon as possible;
- Mark the containers and attach a visible sign stating "do not move or use: awaiting instructions".

LO three

Information sheet 1

Test I

1. **E**
2. **D**

Test II

- General Food Hygiene
- Packaging directives
- Additives and contaminants

- Labeling, presentation and advertising
- Compositional Standards
- The Food Safety Act

Information sheet 2

Test I

1. B
2. C
3. A
4. B
5. E
6. E
7. D

Test II

- Physical hurdles.
- Heat (e.g. blanching, pasteurizing, canning).
- Cold (e.g. chilling and freezing)
- Packaging (e.g. vacuum, aseptic, MAP)
- Physico-chemical hurdles
- Salt, sugar, dehydration, water activity
- Acidity (acidulants, fermentation)
- Sulfur dioxide, smoke, gases, ethanol Chlorine

Information sheet 3

Test I

1. E
2. A
3. A

Test II

- Clean thoroughly with hot, soapy water. Use foam cleaners as applicable.
- Rinse immediately with warm, clean water.
- Apply sanitizer solution as appropriate.

- Air dry.

LO four

Information sheet 1

Test I

1. E
2. A
3. A

Test II

1.

- The skin, and the mucous membranes of the eyes, nose, mouth and throat.

Information sheet 3

Test I

1. A

Test II

1.

- Except in the mildest of cases (shivering), transport the patient.
- During transport, actively re-warm the patient
- Provide care for shock. Provide oxygen, warmed and humidified if possible.
- Give the alert patient warm liquids at a slow rate
- Remove all of the patient's wet clothing

Information sheet 3

Test I

1. A

Test II

- Date of the assessment
- Name of the assessor(s)
- Name of people who provided specialist advice
- The premises, storage location, area or process to which the record relates
- Types hazards
- The sources of information reviewed or used to make decisions
- Identified risks
- Controls necessary to reduce risks

- The existing controls in place
- Any controls that need to be introduced

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The trainers who developed the Curriculum

No.	Name	Qualification	Educational background	Region	E-mail
1	Tesfaye Asrat	B	Animal Science	Amhara	tesfaye99love@gmail.com
2	Tarekegn cheo	B	Agricultural and process Engineering	Sidama	tarekegncheo155@gmail.com
3	Hirpha Ketema	A	Animal Production	Oromia	hirphaketema2@gmail.com
4	Abera Shiferaw	B	Animal production and health	Oromia	aberashiferaw2014@gmail.com