Food Protection Services

# dairy processing plants

## Guidelines for the Application of a Hazard Analysis Critical Control Point (HACCP) Program in a Dairy Plant

BC Centre for Disease Control

# TABLE OF CONTENTS

# Dairy Processing Plants (HACCP)

## INTRODUCTION

Dairy products are considered to be amongst the most nutritionally complete foods. Unfortunately, this characteristic also makes them highly susceptible to bacterial contamination that can lead to outbreaks of food borne disease. Since modern dairy plants are capable of processing large volumes of products, outbreaks can potentially affect large sectors of the population.

The basic approach of the Hazard Analysis Critical Control Point (HACCP) program is to prevent a foodborne disease outbreak from occurring. The HACCP concept was originally developed by the Pillsbury Company for the United States space program, to produce foods which were 100% safe. To achieve this end, Pillsbury controlled all aspects of the food production system including the raw materials, the process, and the environment.

For the dairy plant manager, the HACCP program simplifies dairy product safety by identifying the critical operations and providing effective and efficient methods for monitoring and controlling them. The final outcome is the highest assurance of food safety.

In summary, the benefits of a properly functioning HACCP program include:

- a reduced public health risk
- lower labour costs and more efficient use of resources through elimination of duplication, and
- fewer customer complaints as overall quality improves.

The purpose of this publication is threefold:

- introduce and explain HACCP principles specifically related to a dairy plant operation
- illustrate and describe those Critical Control Points (CCPs) commonly found in dairy plants, and
- provide a schedule for monitoring those CCPs.

While many of the CCPs described in this manual will be found in your dairy plant, differences in processes and procedures between dairy plants will result in CCPs varying between dairy plants. As such, it must be stressed that this manual only outlines the steps in building a HACCP program. Because there is no set formula for developing a HACCP program, each plant must examine their own operation and develop a HACCP program which best suits their operation.

# PART I

# THE HACCP PROGRAM

# APPLICATION TO A DAIRY PLANT

# Dairy Processing Plants (HACCP)

## PART I: THE HACCP PROGRAM - APPLICATION TO A DAIRY PLANT

### *A. INTRODUCTION*

The Hazard Analysis Critical Control Point (HACCP) program is a system which identifies and controls the critical steps in producing safe and wholesome dairy products. The ultimate goal of a HACCP program in the dairy plant is to eliminate all public health risk.

Most steps and procedures required for a HACCP program are likely already being monitored in dairy plants. Many dairy plants need only to reorganize their record keeping system to facilitate full implementation of the HACCP program. As such the actual cost of implementation of a HACCP program is usually quite small.

The following seven (7) principles outline the basics of a HACCP program. These principles, properly applied to a dairy plant, will result in minimizing the potential of a foodborne disease outbreak:

1. Assess the hazards in a dairy plant.
2. Determine critical control points (CCPs).
3. Establish critical limits for each CCP.
4. Implement procedures to monitor CCPs and record data.
5. Institute corrective action.
6. Establish record keeping systems to document the HACCP plan.
7. Verify that the HACCP program is working.

It may appear that the seven principles of the HACCP program, when applied to an entire dairy plant, will be complicated and difficult to organize. However, when the dairy plant is broken down into sections or processes, the number of CCPs becomes quite manageable.

### *B. THE HACCP MANUAL - A STEP BY STEP APPROACH*

Part I of this manual elaborates on how each of the seven principles are applied to a dairy plant. Figure 1 (Page 7) outlines these principles in schematic fashion.

Part II of the manual provides schematics for eleven different sections or processes in a generic dairy plant. Following each schematic is an explanation of the CCPs. As well, methods and schedules for monitoring those CCPs are described.

To facilitate your understanding of this manual, the following information should be read in conjunction with applicable sections of Part II. As such, remove those sections in Part II that most closely mirror your operation and reference them as you read through the remainder of Part I.

# Dairy Processing Plants (HACCP)

## 1. Assess the Hazards in a Dairy Plant

a) Construct a flow diagram of each process in your dairy plant. The flow diagrams in Part II or block diagrams can be used to illustrate each process.

b) The flow diagram(s) should give a clear and simple description of the steps in each process. Include the actual equipment, procedures, and operating practices.

c) List all potential hazards associated with each step in the process. Consider as hazards only those microbiological, chemical, and physical agents that could cause a public health risk. Information provided in Part II and the Appendices will assist you in assessing potential hazards.

d) List any preventive measures (PM) that may exist to control those potential hazards. Preventive measures are those steps or controls in the process designed to eliminate or control a hazard (i.e. pasteurization, hand dip sanitizing).

e) The potential hazards and preventive measures together identify possible CCPs.

## 2. Determine Critical Control Points (CCPs)

a) Once having identified a possible CCP (See Figure 1 - Page 7), four questions will confirm whether or not a CCP exists. These questions are:

(i) Does a preventive measure exist?

(ii) Does this step eliminate or reduce the hazard to an acceptable level?

(iii) Could the hazard contaminate the product?

(iv) Is this preventive measure the last opportunity for eliminating the hazard?

Figure 1 (Page 7) illustrates how answers to each question will confirm the existence of a CCP.

b) Mark each CCP on your flow diagram.

c) The CCPS identified in the schematics in Part II are explained in the accompanying table. These will assist in the identification of CCPs in your dairy plant.

## 3. Establish Critical Limits for each CCP

a) For each CCP, the preventive measure must be fully defined.

b) Critical limits are a set of tolerances for each CCP.

c) Examples of Critical Limits

| Critical Control Point | Critical Limit |
|---|---|
| Refrigeration temperatures. | ≤ 4°C |
| Minimum HTST pasteurization times/temperatures for milk. | 16 seconds at 72°C |
| Response of a flow diversion valve on an HTST pasteurizer | ≤ 1 second |

d) Strict adherence to tolerances is important in maintaining a HACCP program. Product safety is not negotiable; there is no such thing as "almost risk free".

e) Tolerances may vary depending on processes in your plant.

f) For assistance in establishing critical limits, refer to the fourth column in the tables in Part II.

## 4. Implement Procedures to Monitor CCP and Record Data

a) The CCP must be monitored on a regular basis to ensure that it is under control.

b) Examples of such monitoring can include:

(i) inspection of pasteurizer recording charts.

(ii) measurement of sanitizer levels.

(iii) observation of the hygiene of an operation or operator .

c) Records must be kept to ensure the CCPs are being monitored on a regular basis.

d) Several people in the dairy plant may be involved in monitoring CCPs and recording data. As such, information regarding the HACCP program must be effectively communicated. Everyone involved must understand its function and their role in its implementation in order to be assured of its success.

e) The third column in the table in Part II under "Monitoring Frequency" provides a timetable for monitoring CCPs. The timetable for monitoring CCPs may vary between dairy plants.

## 5. Institute Corrective Action

a) In any HACCP program, a CCP may fail. As such, corrective action plans must be included as a part of the program.

b) For each CCP, a specific corrective action must be in place in the event of a CCP deviation from the critical limit tolerance. Action must include:

(i) Procedure for holding product pending completion of analysis to confirm product safety.

(ii) Disposition of the product if necessary.

c) If a product cannot be proven safe, then it must be disposed of, or if possible, safely reworked.

d) As well, the reasons for deviations must be found, documented, and corrected.

e) The fifth column under " Actions on Deviations" in each table of Part II lists appropriate actions to take when CCP criteria are not met.

## 6. Establish Record Keeping Systems to Document HACCP Plan

a) A single individual should be made responsible for ensuring all data is collected and recorded. This individual must have authority to ensure:
   (i) all data is collected
   (ii) all data is centrally located and thus easy to retrieve
   (iii) a record of all CCP deviations is kept, and, most importantly
   (iv) appropriate action is taken when results deviate beyond the critical limits.

b) The record keeping system must be as simple as possible. A single binder for smaller operations or a single filing cabinet for larger operations should be more than adequate.

## 7. Verify that the HACCP Program is Working

a) Most dairy plants are now performing regular quality control testing of their finished products. Results from quality control tests can often indicate that a HACCP program is not performing as required. In such cases, the program must be reviewed to ensure:
   (i) the present HACCP program is being followed
   (ii) all hazards were identified in the initial HACCP program

b) Other methods to verify the HACCP program is working include:
   (i) Close monitoring of consumer complaints.
   (ii) Verification inspections: unannounced equipment inspections.
   (iii) Regular review of the current HACCP program. Have processes, procedures, or formulations changed since the initial HACCP program was implemented?
   (iv) Random sample collection and testing (separate from regular QC/QA testing protocol).

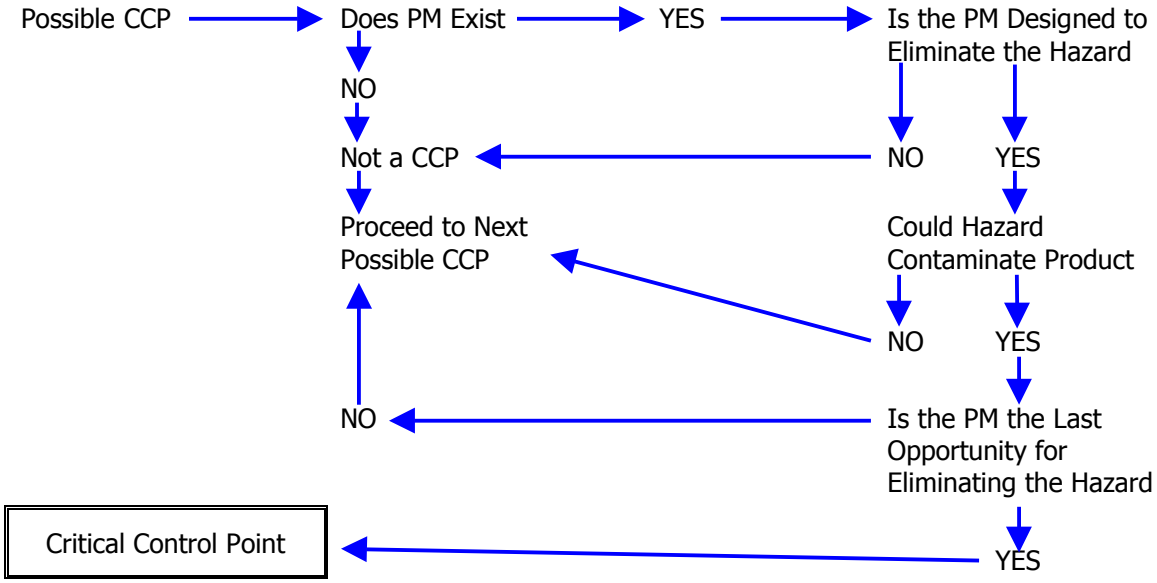
c) It is particularly important to ensure the HACCP program is working when it is first installed. As well, verification procedures must be made a priority when any changes in processing procedures or formulations are made.

## FIGURE 1: HACCP Decision-Making Chart

1. Assess the Hazards in a Dairy Plant

Construct Flow Diagram of Process → List all Identified Hazards AND List all Preventive Measures (PM) → Possible CCP

2. Determine CCPs




3. Establish Critical Limit for each CCP

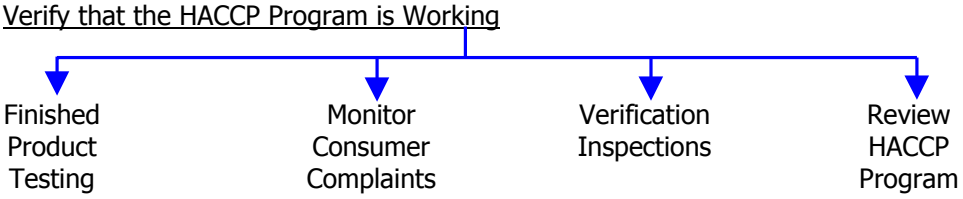
See Part II for Examples

4. Implement Procedures to Monitor CCPs and Record Data

5. Institute Corrective Action

6. Establish Record Keeping Systems

7. Verify that the HACCP Program is Working



# PART II

# THE HACCP PROGRAM

# CRITICAL CONTROL POINTS

# IN A

# DAIRY PLANT

# PART II THE HACCP PROGRAM - CRITICAL CONTROL POINTS IN A DAIRY PLANT

## *A. INTRODUCTION*

Part II provides schematics for 11 different processes commonly found in dairy plants. The schematics illustrate hazards which could be present in a dairy plant. Following each schematic is a table detailing the CCPs and the means to monitor them. Recommended monitoring frequencies and critical limits for the CCPs are outlined. Recommended actions for CCP deviations are also provided.

Section 11 of Part II, Dairy Plant - Universal Control Points, identifies those hazards that may not have specific critical control points. One such example is pest control. Pests represent a hazard because they can act as a source of contamination. Pests cannot be effectively controlled by assignment of critical control points. Rather, the implementation of an effective pest control program will be more effective in preventing their entry into the dairy plant. This is but one of many examples of potential hazards that are more effectively managed by ensuring that good manufacturing practices are followed. These are often referred to as Universal Control Points. Other examples of Universal Control Points include:

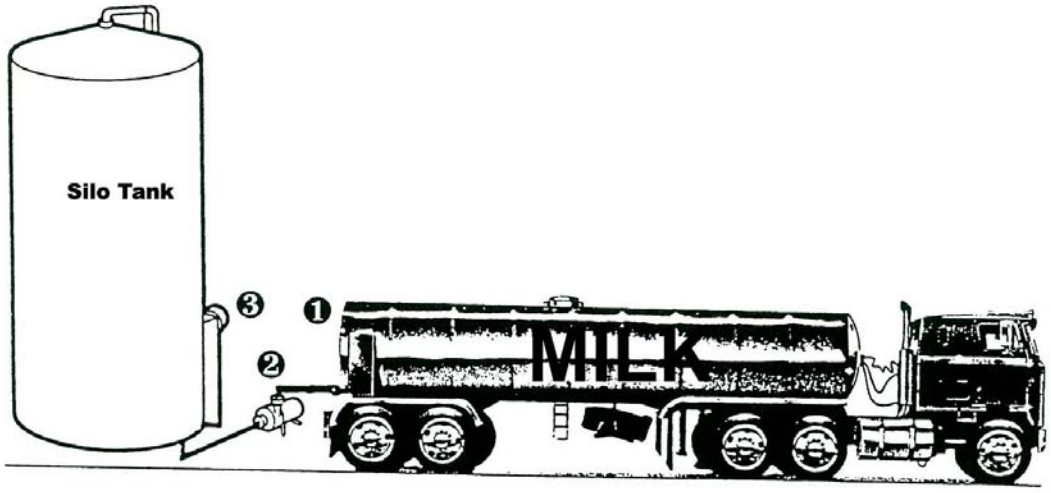
- equipment maintenance program
- worker education and training program
- equipment inspection program
- general environmental sanitation program
- cross-connection control.

These and other examples of commonly found Universal Control Points are more fully explained in Section 11 of Part II.

The schematics and accompanying information have been provided to act as a model or building block for a HACCP program. Because procedures, equipment, and plant designs vary greatly between dairy plants, the information provided in Part II will not necessarily include all hazards found in your dairy plant. In order to implement an effective HACCP program, the dairy plant manager must follow the steps outlined in Part I while using the information provided in Part II as a guide or model for a HACCP program.

## *B. SECTIONS OR PROCESSES IN A DAIRY PLANT*

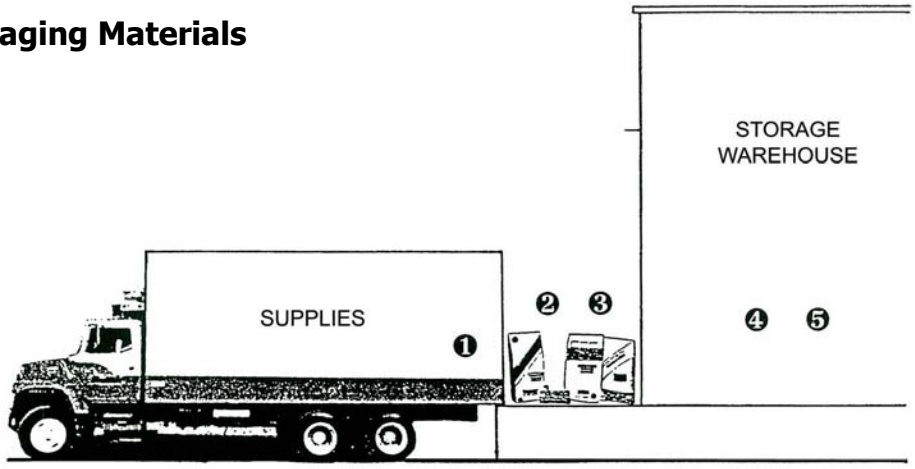
### 1. Raw Milk Supply




### 1. Raw Milk Supply - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Milk/Cream Acidity | Measure acidity of milk. | Before accepting each tanker load or container and immediately prior to use. | Milk:<br>TA: 0.14-0.17<br>pH: 6.6-6.8<br>Cream:<br>TA: 0.10-0.12<br>pH: 6.6-6.8 | Do not process product. |
| 2. Milk Temperature | Measure temperature of milk | Before accepting each tanker load or container and immediately prior to use. | ≤ 4°C | Hold. Do not process until milk acidity has been tested. |
| 3. Presence of Antibiotics | Test milk for presence of antibiotics. | Before accepting each tanker load or container. | No antibiotics | Reject any loads containing antibiotics. |

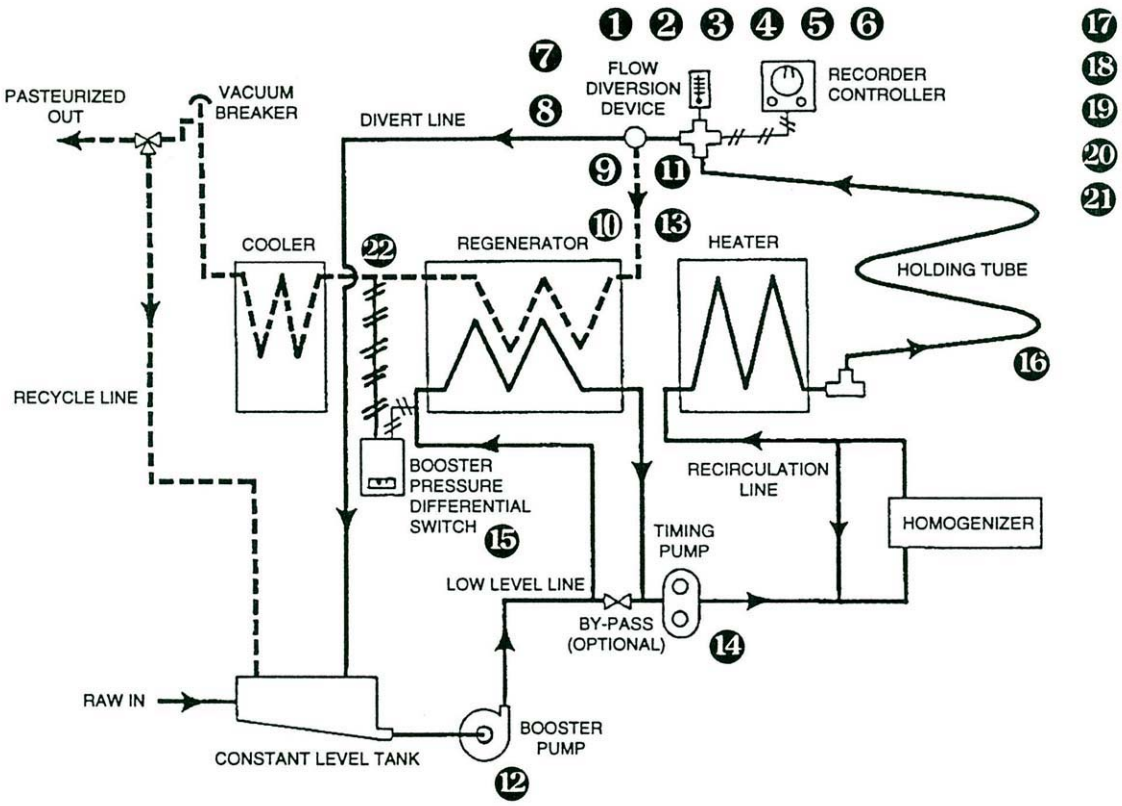
## 2. Ingredients/Packaging Materials




### 2. Ingredients/Packaging Materials

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Receipt of Ingredients | Ensure each shipment is received in good condition. | Before accepting each shipment of ingredients. | Ingredient containers are intact. No signs of possible outside contamination (chemical or physical adulteration, pest infestation). | Reject any ingredients which may be compromised. |
| 2. Supplier Standards | Obtain standards for each ingredient from supplier. | With every ingredient or supplier. Verify standards annually. | All ingredients are food grade. All ingredients meet microbiological/chemical standards for finished product. | Do not use any ingredients that do not meet standards. |
| 3. Verification of Standards | Verify that ingredients comply with supplier standards. | Request test results from supplier for each lot received. Obtain independent test results. | Within supplier standards. | Do not use any ingredients that do not meet supplier standards. Contact supplier. |
| 4. Storage of Ingredients. | Store ingredients as recommended by supplier and away from potential contaminants. | As each shipment of ingredients is received. Check ingredient storage areas monthly for contamination potentials. | As recommended by supplier. Stored separately from any potential contaminating products. (i.e. cleaners, petroleum). | Do not use any ingredient which may be compromised. |
| 5. Re-useable Dairy Cases | Ensure that cleaning and sanitizing procedures for returned dairy cases are adequate. | Ongoing, daily. | All returned cases are clean and sanitary before re-use. | Review cleaning and sanitizing procedures. Adjust as necessary. |

## 3. HTST Pasteurization




### HTST Pasteurization Requirements

| Dairy Product | Time/Temperature |
|---|---|
| fluid milk | 16 seconds at 72°C |
| cream (≥ 10% BF) | 16 seconds at 75°C |
| ice cream,<br>ice cream mix, and<br>sugared dairy beverage | 25 seconds at 80°C |

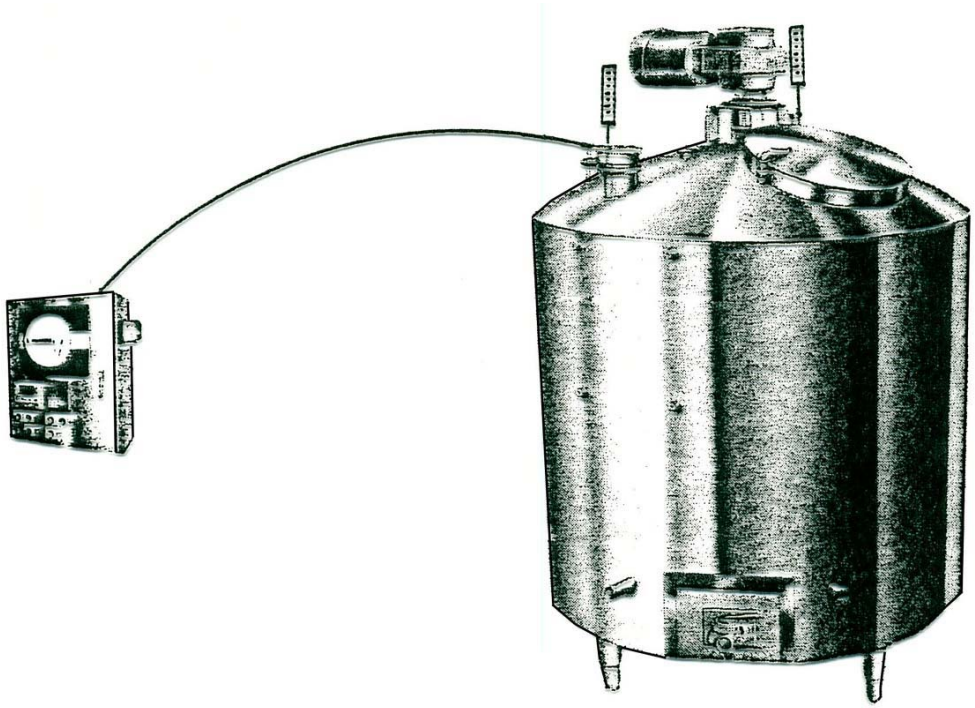
# Dairy Processing Plants (HACCP)

## 3. HTST Pasteurization - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Indicating Thermometer - Temperature Accuracy | Verify that indicating thermometer is reading accurately. | Upon installation and every 3 months | ±.5°C | Adjust if possible, otherwise replace thermometer. |
| 2. Recording Thermometer - Temperature Accuracy | Verify that indicating thermometer is reading accurately. | Upon installation and every 3 months | ±.5°C | Adjust if possible, otherwise replace thermometer. |
| 3. Indicating Thermometer - Thermometric Response | Verify that indicating thermometer complies with thermometric standard. | Upon installation and every 3 months | Through specified 7°C range in ≤ 4 seconds. | Replace thermometer. |
| 4. Recording Thermometer - Thermometric Response | Verify that indicating thermometer complies with thermometric standard. | Upon installation and every 3 months | Through specified 7°C range in ≤ 5 seconds. | Repair if possible, otherwise replace thermometer. |
| 5. Recording Thermometer - Time Accuracy | Verify that recorded time is equal to the elapsed times. | Upon installation and every 3 months | Recorded time equals true elapsed time. | Repair if possible, otherwise replace. |
| 6. Recording Thermometer - Check Against Indicating Thermometer | To verify that the recording chart is in agreement with the indicating thermometer. | Upon installation, and daily | Must be accurate to within .5°C and not read otherwise higher than indicating thermometer. | Adjust if possible, otherwise replace. |
| 7. Cut-in and Cut-out Temperatures | Verify that flow diversion valve cuts in and cuts out above minimum pasteurization temperature. | Upon installation, and daily | ≥ minimum pasteurization temperatures. | Repair immediately. Recall/rework under-processed products. |
| 8. Leakage Past Valve Seat(s) | Verify that raw milk does not leak past the flow diversion device. | Upon installation, and every 3 months | No leakage past flow diversion valve seat and leak detect valve seat. | Repair immediately. |
| 9. Operating Valve Stem(s) | Verify that the valve moves freely when the stuffing box is fully tightened. | Upon installation, and every 3 months | Valve stem moves with ease. | Repair immediately. |
| 10. Single Stem Device - Proper Assembly/Function | Verify the metering pump and all flow promoters stop when the device is improperly assembled. | Upon installation, and every 3 months | The metering pump and all flow promoters stop as a result of test procedures. | Repair immediately. |
| 11. Dual Stem | Verify the metering pump and all flow promoters stop when the device is improperly assembled. | Upon installation, and every 3 months | The metering pump and all flow promoters stop as a result of test procedures. | Repair immediately. |
| 12. Booster Pump Deactivation - Manual Diversion | Verify the booster pump stops when the flow diversion device is manually diverted. | Upon installation, and every 3 months | Booster pump de-activation on diverted flow and maintenance of pressure differential. | Repair immediately. |

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 13. Flow Diversion Valve - Response Time | Verify the flow diversion valve moves to the diverted position in the specified time. | Upon installation, and every 3 months | Fully diverted position in ≤ 1 second. | Repair immediately. |
| 14. Metering Pump - Time Delay Interlock | Verify the metering pump is deactivated on "inspect" mode. | Upon installation, and every 3 months | Full metering pump deactivation prior to forward position is assured. | Repair immediately. |
| 15. Pressure Differential Controller - Proper Operation | Verify the pressure differential controller is installed and operating properly. | Upon installation, and every 3 months | Booster pump deactivation at < 2 psi pressure differential. | Repair immediately. |
| 16. Holding Tube - Holding Time | Verify that every particle of milk is held for the minimum holding time. | Upon installation, semi-annually and whenever any changes affecting the holding time are made | ≥ minimum computed holding time. | Repair immediately. |
| 17. Meter Based Timing - High Flow Alarm | Product flow is diverted when the event pen indicates a diversion. | Upon installation, and every 3 months | Immediate flow diversion valve movement to divert position when event pen indicates diverted flow. | Repair immediately. |
| 18. Meter Based Timing - Flow Cut-In/Cut-Out | Verify product cut-in/cut-out flow rate. | Upon installation, and every 3 months | Cut-in/Cut-out are less than. maximum legal flow rate. | Repair immediately. |
| 19. Meter Based Timing - Loss of Signal Alarm | Verify that product is diverted when the transmitter fails. | Upon installation, and every 3 months | Diverted flow when loss of transmitter signal occurs. | Repair immediately. |
| 20. Meter Based Timing - Time Delay Relay on Forward Flow | Verify that the time delay for entering forward flow is adequate. | Upon installation, and every 3 months | Time delay is greater than the minimum legal holding time. | Repair immediately. |
| 21. CIP Mode - Time Delay Relay | Verify the flow diversion valve remains in diverted flow for an adequate time upon CIP mode switch activation. | Upon installation, and every 3 months | Time delay is at least 10 minutes. | Repair immediately. |
| 22. Heat Exchange Plates - Perforation Detection | Using a recognized test method verify that heat exchange plates contain no pin holes or cracks. | Annually | No pin holes or cracks. | Repair immediately. |

## 4. Vat Pasteurization



### Vat Pasteurization Requirements

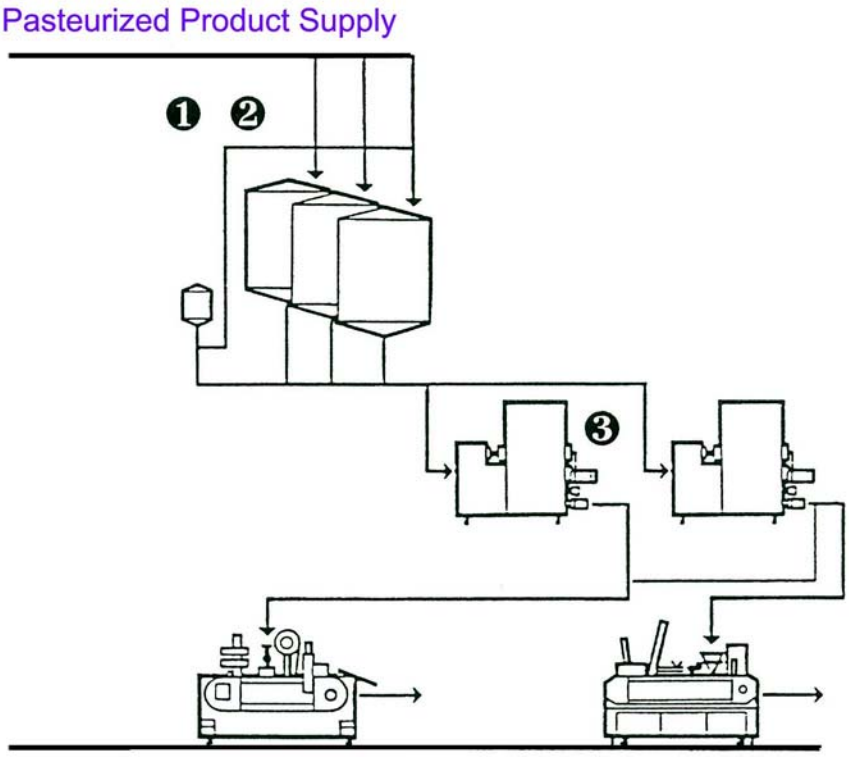
| Dairy Product | Time/Temperature |
|---|---|
| fluid milk | 30 minutes at 63°C |
| cream (≥ 10% BF) | 30 minutes at 66°C |
| Ice cream<br>ice cream mix, and<br>sugared dairy beverage | 30 minutes at 69°C |

# Dairy Processing Plants (HACCP)

## 4. Vat Pasteurization - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Indicating Thermometer - Entry on Recording Chart | Operator notes indicating thermometer temperature on recording chart at beginning of holding time. | Each batch processed | Temperature must be ≥ the minimum pasteurization temperature. | Increase temperature to ≥ the minimum pasteurization temperature. |
| 2. Airspace Thermometer - Entry on Recording Chart | Operator notes airspace thermometer temperature on recording chart at beginning of holding time. | Each batch processed | Temperature must be at least 3°C higher than the minimum pasteurization temperature. | Increase temperature to achieve an airspace temperature of 3°C higher than the minimum pasteurization temperature. |
| 3. Indicating Thermometer - Temperature Accuracy | Verify the recording thermometer reflects the true processing temperature. | Upon installation and every 3 months | ±0.5°C of test indicating thermometer. | Adjust or replace. |
| 4. Recording Thermometer - Temperature Accuracy | Verify the recording thermometer reflects the true processing temperature. | Upon installation and every 3 months and wherever recording pen requires frequent adjustment | ±0.5°C of verified indicating thermometer. | Adjust or replace. |
| 5. Air Space Thermometer - Temperature Accuracy | Verify the airspace thermometer reflects the true processing temperature. | Upon installation and every 3 months | ±0.5°C of verified indicating thermometer. | Adjust or replace. |
| 6. Recording Thermometer - Temperature Accuracy | Verify the recorded time of pasteurization is the same as true elapsed time. | Upon installation and every 3 months | Recorded time equals true elapsed time. | Repair or replace. |

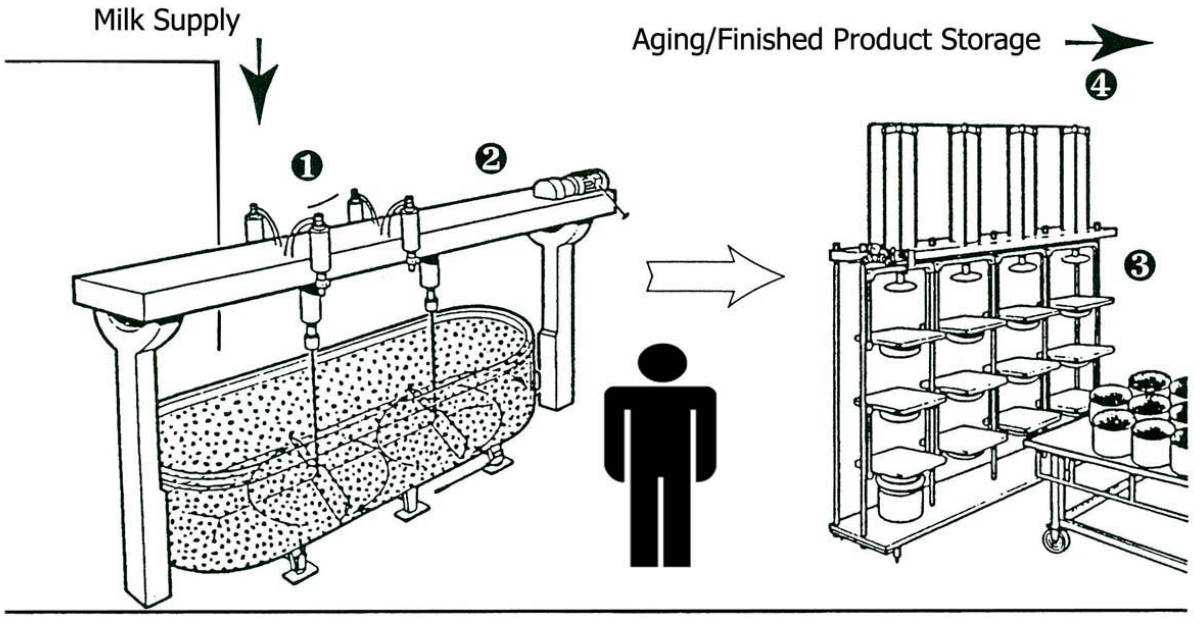
## 5. Ice Cream Pasteurized Product Supply




### 5. Ice Cream - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Post - Pasteurization Ingredients - Hygienic Addition | Verify that addition procedures, measuring containers, etc. are hygienic. | Ongoing | All procedures must follow good manufacturing practices. | Modify procedures as necessary. |
| 2. Post-Pasteurization Ingredients - Pre Addition Inspection | Post pasteurization ingredients are inspected immediately prior to addition. | Each addition | Correct post- pasteurization ingredients are being added and no signs of contamination are present. | Reject any incorrect or questionable post- pasteurization ingredients. |
| 3. Air Supply to Freezer - Quality Inspection | Verify that area around air intake to freezer is hygienic. | Daily | Area around air intake must be clean and sanitary. | Clean as necessary. |

## 6. Cheese



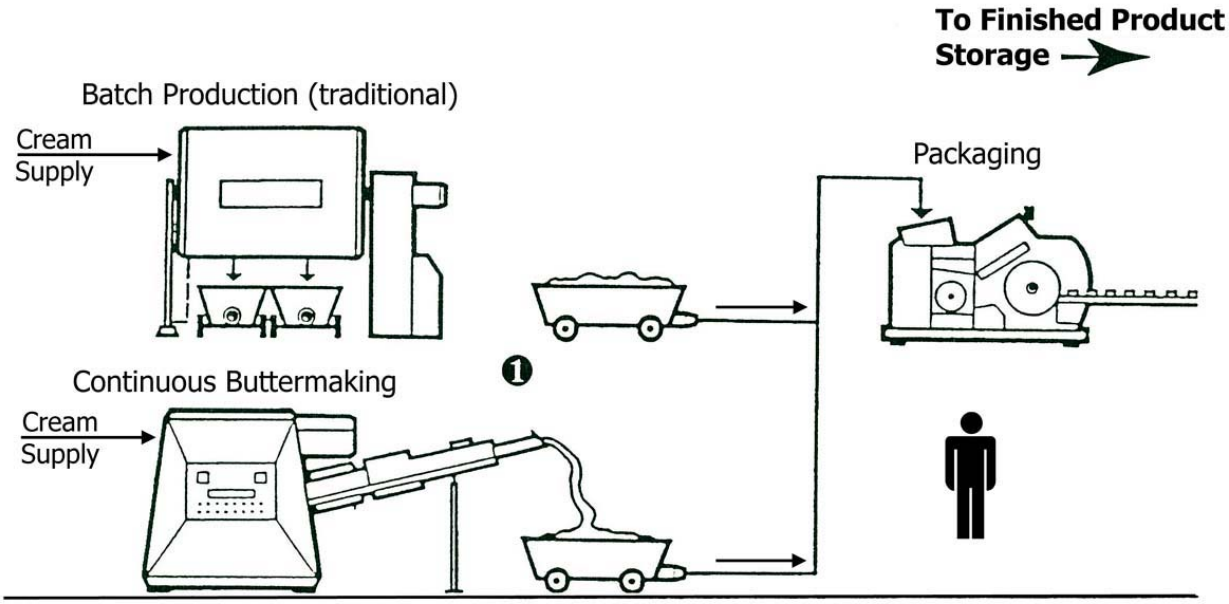

### 6. Cheese - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Post - Pasteurization Ingredients - Hygienic Addition | Verify that addition procedures, measuring containers, etc. are hygienic. | Ongoing | All procedures must follow good manufacturing practices. | Modify procedures as necessary. |
| 2. Cheese Curd- Acid Development | Verify that acid development is occurring as per usual. | Each vat | Acid development must occur at a rate established for each type of cheese or process. | Any "slow" vats must be micro-biologically tested prior to release for sale. |
| 3. Re-useable Containers - Sanitary Condition | Verify that procedures to clean and sanitize reusable containers (ie: moulds) are adequate. | Daily | All re-useable containers must be clean and sanitized. | Reject any unsanitary containers. Review cleaning/sanitizing procedures and adjust as necessary. |
| 4. Unpasteurized Milk Cheese – 60 Day Storage | Verify that record keeping practices and procedures ensure all unpasteurized milk cheese is properly aged. | Ongoing | All unpasteurized milk cheese must be aged for a minimum of 60 days. | Modify record keeping practices and procedures as necessary. |

# Dairy Processing Plants (HACCP)

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 5. Liquid Culture Application – Spray Bottle Method | Verify that procedures to produce liquid cultures and procedures to clean and sanitize reusable containers (spray bottle and mechanism) are adequate. | Daily | a) Liquid cultures are produced in a hygienic and sanitary fashion.<br>b) All non-culture ingredients are treated as necessary to ensure all bacterial contaminants are destroyed.<br>c) Liquid cultures are used immediately after being produced and then discarded.<br>d) Emptied containers are washed and sanitized prior to fresh liquid culture being introduced. Washing/sanitizing includes the sprayer mechanism. | Discard any cheese exposed to liquid cultures not meeting critical limits OR test each batch for L. monocytogenes, Salmonella, E. coli and S. aureus. |
| 6. Liquid Culture Application – Manual Method | Verify that procedures to produce liquid cultures and procedures to clean and sanitize re-usable containers are adequate. | Daily | a) Liquid cultures are produced in a hygienic and sanitary fashion.<br>b) All non-culture ingredients are treated as necessary to ensure all bacterial contaminants are destroyed.<br>c) Liquid cultures are used immediately after being produced and then discarded.<br>d) Application utensils (e.g. cloths, rubbing brushes) and hands are thoroughly washed and sanitized immediately prior to manual liquid culture application.<br>e) Emptied containers are washed and sanitized prior to fresh liquid culture being introduced. | Discard any cheese exposed to liquid cultures not meeting critical limits OR test each batch for L. monocytogenes, Salmonella, E. coli and S. aureus. |

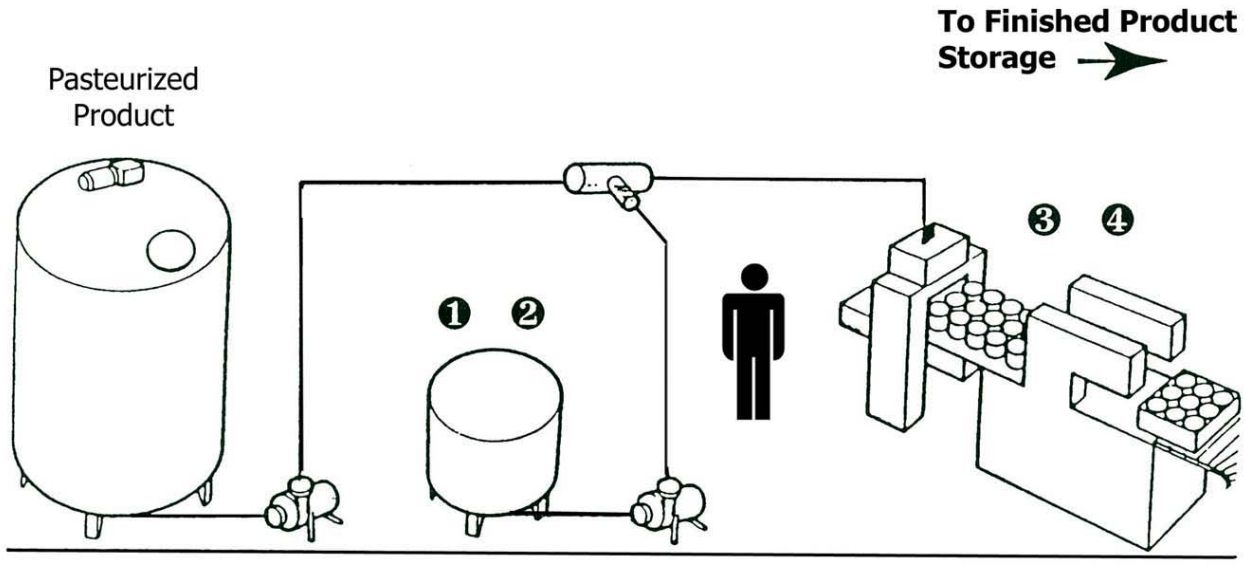
## 7. Butter




### 7. Butter - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Post-Pasteurization Ingredients – Hygienic Addition | Verify that addition procedures, measuring containers, etc. are hygienic. | Ongoing | All procedures must follow good manufacturing practices. | Modify procedures as necessary. |

## 8. Cultured Products



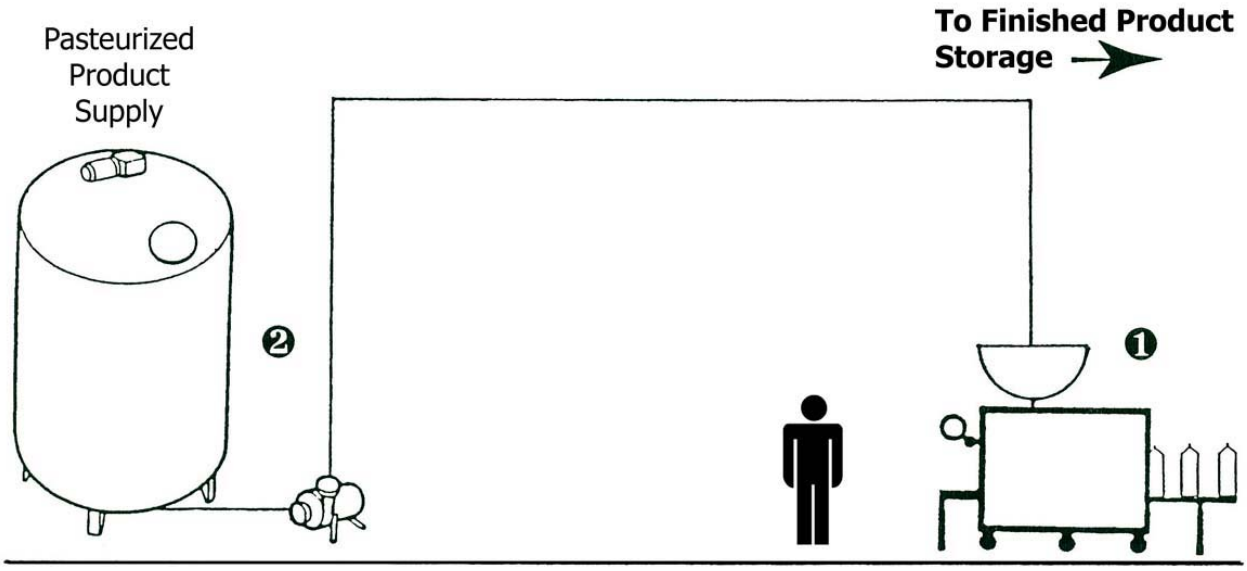

### 8. Cultured Products - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Post-Pasteurization Ingredients – Hygienic Addition | Verify that addition procedures, measuring containers, etc. are hygienic. | Ongoing | All procedures must follow good manufacturing practices. | Modify procedures as necessary. |
| 2. Post-Pasteurization Ingredients – Pre Addition | Post-pasteurization ingredients are inspected immediately prior to addition. | Each addition | Correct post-pasteurization ingredients are being added and no signs of contamination are present. | Reject any incorrect or questionable post-pasteurization ingredients. |

# Dairy Processing Plants (HACCP)

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| Inspection | | | | |
| 3. Finished Product Acid Development | Verify that acid development is occurring as per usual. | Each vat or set | Acid development must occur at a rate as established for each type of product being produced. | Any "slow" vats or sets must be micro-biologically tested prior to release for sale. |
| 4. Re-usable Containers - Sanitary Condition | Verify that procedures to clean and sanitize re-usable containers (i.e. bottles) are adequate. | Daily | All re-usable containers must be clean and sanitized. | Reject any unsanitary containers. Review cleaning/sanitizing procedures and adjust as necessary. |

## 9. Fluid



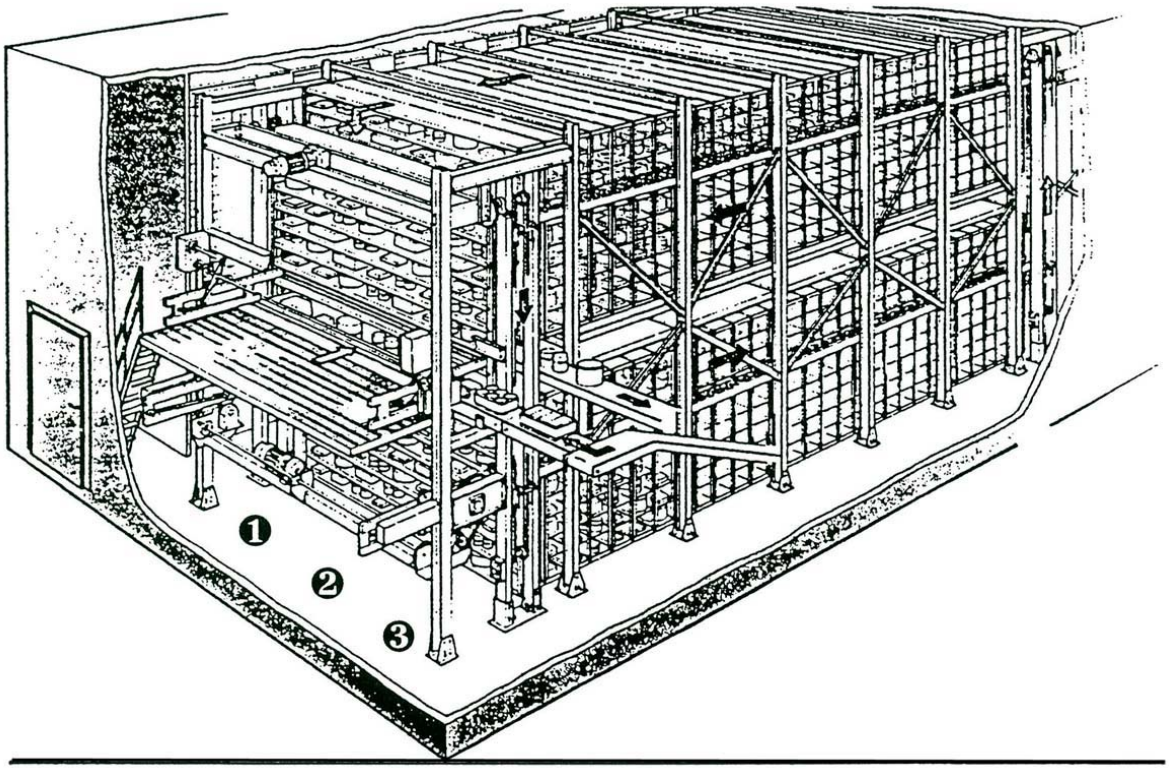

### 9. Fluid - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Re-usable Containers – Sanitary Condition | Verify that procedures to clean and sanitize re-usable containers (i.e. bottles) are adequate. | Daily | All re-usable containers must be clean and sanitized. | Reject any unsanitary containers. Review cleaning/sanitizing procedures and adjust as necessary. |

# Dairy Processing Plants (HACCP)

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 2. Vitamin Addition Control | Verify that Vitamin A/D and Vitamin D are added in the correct concentration. | Daily | Vitamin additions do not exceed maximum allowable limits. | Reject any finished product lots that exceed maximum allowable limits. Review vitamin addition procedures and adjust as necessary. |

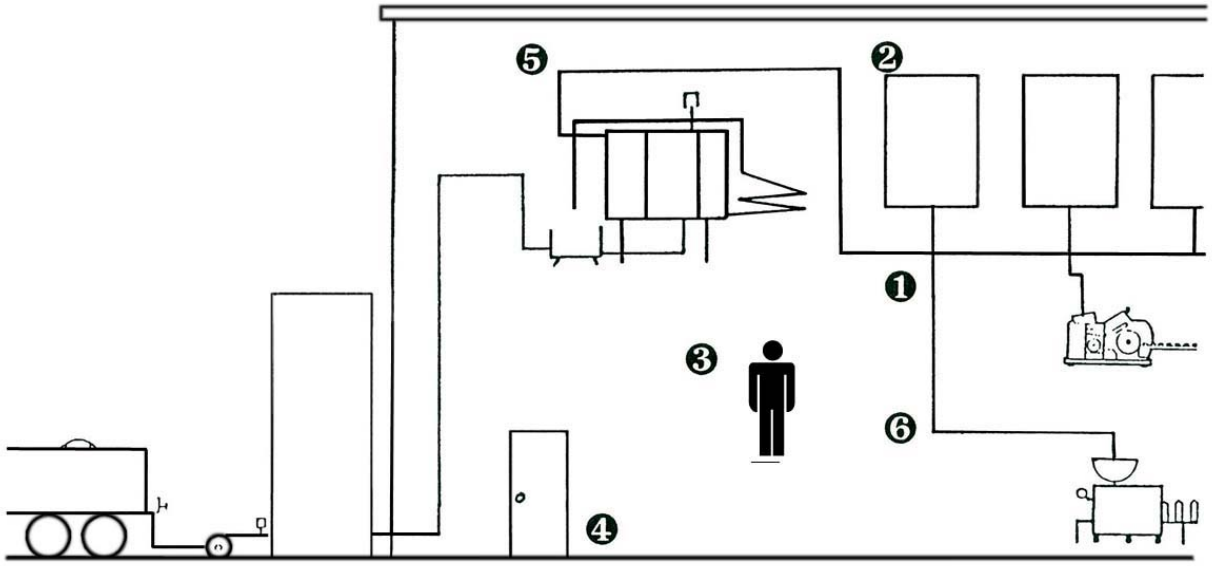
## 10. Finished Product Storage




### 10. Finished Product Storage - Critical Control Points

| CRITICAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Storage Temperature | Verify finished product storage areas are maintained below maximum allowable temperatures. | Ongoing, daily | a) Ice Cream: < -18°C<br>b) Butter, cultured products, fluid: ≤ 4°C<br>c) Cheese<br>- soft: ≤ 4°C<br>- hard: may be higher than 4°C during aging process. (Dependent on cheese type). | Review cooling capacity for storage areas. Adjust or make modifications or improvements as necessary. |
| 2. Multiple Use of Finished Product Storage Area | Verify that any other items stored in the finished product storage area are not potential contaminants. | Ongoing | Any potential contaminants (cleaners, petroleum products) are stored separately from finished products. | Immediate removal of potential contaminants. |
| 3. Returned Products | Verify that isolation procedures for returned products are adequate. | Ongoing | Isolation procedures must ensure returned product cannot be resold or reused. | Review isolation and disposal procedures. Adjust as necessary and monitor effectiveness of changes. |

## 11. Dairy Plant - Universal Control Points




### 11. Dairy Plant - Universal Control Points

| UNIVERSAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 1. Equipment Inspection – CIP Effectiveness | Inspect all equipment to ensure that regular CIP procedures are adequate for removal of all soil. | Ongoing, monthly | All product contact surfaces are free of soil and chemical residues. | Review CIP procedures. Adjust as necessary and monitor effectiveness after changes. |
| 2. General Environment – Sanitary Condition and Design | Inspect general environment (walls, ceilings floors, overhead lines, mezzanines etc.) to ensure finished product quality cannot be compromised. | Ongoing, monthly | General environmental must be in clean and sanitary condition. Ensure that plant design does not allow for leaks, splashes, etc. to enter product. | Review cleaning and sanitation procedures for general environment. Adjust as necessary. |
| 3. Personnel Practices | Verify that all personnel practices (handling of ingredients, finished product, product contact surfaces; hose use; etc.) cannot compromise finished product quality. | Ongoing | All personnel must follow good manufacturing practices. Only essential staff may enter the processing area. Upon entering clothing, including shoes must be changed. | Modify practices as necessary. |
| 4. Pest Control | Verify that all pest control procedures for excluding and eliminating pests are adequate. | Ongoing, monthly | Absence of pest activity. | Review pest control procedures. Adjust as necessary and monitor effectiveness after changes. |

# Dairy Processing Plants (HACCP)

| UNIVERSAL CONTROL POINT | ACTION | MONITORING FREQUENCY | CRITICAL LIMITS | ACTION ON DEVIATIONS |
|---|---|---|---|---|
| 5. Cross Connection Control | Examination of equipment to verify that no potential cross-connection exists. | Ongoing, after any installations or changes are made | Absence of potential cross-connections. | Immediate removal of potential cross-connections. |
| 6. Ingredients Listing – Allergen Control | Comparison between ingredients listing on package label and actual ingredients being used. | Ongoing, after any changes to formulations are made | All ingredients used must be noted on the ingredients listing on the package label. | Determination of potential allergenic reaction of unlisted ingredients. Immediate withdrawal from distribution system/public recall may be necessary. |

# APPENDICES

## *A. HAZARDS IN A DAIRY PROCESSING PLANT - PUBLIC HEALTH SIGNIFICANCE*

### 1. Raw Milk Supply

1. Milk/Cream Acidity:

a) High Acidity - may indicate either:
- Sour milk: due to growth of bacteria including pathogens
OR
- Chemical adulteration by an acidic product or cleaner.

b) Low Acidity - indicates chemical adulteration by a soap or cleaner.

2. Milk Temperature

At temperatures >4°C, pathogen growth is accelerated. Pasteurization may not destroy all pathogens in highly contaminated milk and is unable to destroy certain toxins of microbial origin.

3. Presence of Antibiotics:

Consumption of milk products containing antibiotics can, in certain cases, produce severe allergic reactions that could result in death.

## 2. Ingredients/Packaging Materials

1. Receipt of Ingredients:

Ingredients are often transported long distances, possibly on several carriers and stored in several warehouses. Every step in the loading/transport process increases the likelihood that containers may be contaminated (chemical, pest).

2. Supplier Standards:

Requesting standards for each ingredient from your supplier(s) will help ensure that all ingredients are food grade and microbiological/chemical standards for finished products are met. Remember that a dairy plant may be held responsible for a food poisoning outbreak regardless of the source of contamination.

3. Verification of Standards:

Periodic testing of suppliers' products ensures that agreed upon ingredient standards are maintained.

4. Storage of Ingredients:

Improper storage of ingredients can result in an adulterated finished product. All food ingredients must be stored away from potential non-food contaminants such as oil, cleaners, etc. As well, ingredients that have potential allergic responses should be well marked and located such that the possibility of being used in the wrong product is greatly reduced.

5. Re-useable Dairy Cases:

Returned dairy cases are a potential source of contamination to the dairy plant environment. As such, the dairy cases must be adequately cleaned prior to entry into the processing/packaging areas.

## 3. HTST Pasteurization

For detailed information refer to the *HTST Design and Operational Criteria* found in *Part I of the Code of Good Practice for High Temperature Short Time*.

## 4. Vat Pasteurization

For detailed information refer to the *Batch Pasteurizers Design and Operational Criteria* found in Part II of the *Code of Good Practice for High Temperature Short Time*.

## 5. Ice Cream

1. Post-Pasteurization Ingredients - Hygienic Addition:

Improper or unhygienic addition of post-pasteurization ingredients can result in contaminated finished product.

2. Post-Pasteurization Ingredients - Pre-Addition Inspection:

Because transport of post-pasteurization ingredients to the dairy plant can involve several carriers and storage in many warehouses, the likelihood of some type of contamination (chemical, physical, pest, rodents) is increased. As well ingredient containers have been known to be mislabelled which could result in potential allergens being present in the finished product.

3. Air Supply to Freezer - Quality Inspection:

Air added to the ice cream must be considered a post-pasteurization ingredient. As such, air quality must meet finished product quality standards.

## 6. Cheese

1. Post-Pasteurization Ingredients - Hygienic Addition:

Improper addition of post-pasteurization ingredients can result in a contaminated finished product.

2. Cheese Curd - Acid Development:

Slow acid development creates the opportunity for a pathogen to grow to hazardous levels.

3. Re-useable Containers - Sanitary Condition:

Should the cheese making process re-use containers/utensils (hoops, screens, molds, etc.), steps must be taken to ensure re-useable containers are adequately cleaned and sanitized prior to re-use.

4. Unpasteurized Milk Cheese - 60 Day Storage:

Several varieties of cheeses are made from unpasteurized milk. In order to help ensure all pathogens are destroyed, the finished cheese must be stored for a minimum of 60 days. Storage records and stock rotation must be accurate and reliable to ensure all cheese is stored for the minimum 60 day period.

5. Liquid Culture – Application Spray Bottle or Manual Method:

Listeria monocytogenes can grow in liquid cultures, even if refrigerated. Effective management techniques are needed to prevent contamination from occurring. Further, equipment needs to be routinely cleaned and sanitized to break the growth cycle should accidental contamination occur.

## 7. Butter

1. Post-Pasteurization Ingredients - Hygienic Addition:

Improper or unhygienic addition of post-pasteurization ingredients can result in a contaminated finished product.

## 8. Cultured Products

1. Post-Pasteurization Ingredients - Hygienic Addition:

Improper or unhygienic addition of post-pasteurization ingredients can result in a contaminated finished product.

2. Post-Pasteurization Ingredients - Pre-Addition Inspection:

Because transport of post-pasteurization ingredients to the dairy plant can involve several carriers and storage in many warehouses, the likelihood of some type of contamination (chemical, physical, pest, rodents) is increased. As well, ingredient containers have been known to be mislabelled which could result in potential allergens being present in the finished product.

3. Finished Product - Acid Development:

Slow acid development creates the opportunity for a pathogen to grow to hazardous levels.

## 9. Fluid

1. Re-useable containers - Sanitary Condition:

In some dairy plants, fluid products are filled into reusable containers which have been returned by the consumer. The dairy plant has no control over the use of the container after it leaves the dairy plant. As such, adequate steps must be taken to ensure all returning containers are thoroughly washed and sanitized in order to remove any contaminating material.

2. Vitamin Addition Control:

Consumption of milk containing high concentrations of Vitamin D can result in severe illness and even death. As such, the addition of Vitamin D to fluid milk must be carefully controlled.

## 10. Finished Product Storage

1. Storage Temperature:

a) Ice Cream - from a HACCP viewpoint, ice cream could be stored at <4°C with no increase in public health risk. However, for quality considerations, ice cream should be stored at < - 18°C.

b) Butter, Cultured Products, Fluid - at temperatures > 4°C, contaminating bacteria can increase in numbers to the point where they can become a public health risk.

c) Cheese Soft: because of the lower acid and higher moisture levels, soft cheeses must be stored similar to cultured products. As such, soft cheeses must be stored at ≤4°C.

Hard: several hard cheese varieties can be aged at temperatures >4°C. This is necessary to ensure the cheese develops flavour properly.

2. Multiple Use of Finished Product Storage Area:

Any potentially contaminating items such as cleaners, petroleum products, odorous compounds, etc. must be stored in an area separate from finished products or ingredients. Contamination can occur due to spillage, transfer of odours, etc. if incompatible items are stored with finished products or ingredients.

3. Returned Product:

The dairy plant licencee has no control over the handling/storage of finished product after it leaves the dairy plant. As such it must be assumed that all returned product is contaminated and unfit for use as rework. Further, returned product must be properly segregated from finished product to ensure that:

a) Returned product is not accidentally re-sold as regular finished product.

b) Returned product is not accidentally re-used.

c) Contaminated containers and cases do not contaminate finished product storage areas or processing areas.

## 11. Dairy Plant – Universal Control Points

1. Equipment Inspection - CIP Effectiveness:

After pasteurization, proper cleaning of equipment is the most critical process in ensuring a finished product free from contamination. As such, an adequate in-house inspection program must be implemented to ensure that all equipment involved in the processing, storage, and packaging of dairy products is properly cleaned.

2. General Environment - Sanitary Condition:

A contaminated environment increases the likelihood of finished product contamination. Non-essential personnel and the public must not be allowed to access the production areas. Essential personnel must change their outer wear, including shoes prior to entering the production area. Further, condensation, insects and rodents, plugged drains, personnel practices, dust, are other examples of potential sources of environmental contamination. As such, a regular cleaning and inspection program of the general environment must be implemented in any dairy processing plant.

As well, the general design of the dairy plant must be examined with respect to design faults that may lead to contamination. Examples of poor design include mezzanines, stairs, ladders, case conveyors, or dripping overhead lines being over or adjacent to exposed product. Special preventative measures must be implemented if design flaws exist in your dairy plant.

3. Personnel Practices:

Dairy plant personnel are potential carriers of pathogenic organisms. As a result, every effort must be taken to ensure that hands are adequately washed and sanitized prior to touching product contact surfaces or post-pasteurization ingredients. Workers suspected or known to be carriers of a communicable disease must be excluded until receiving medical clearance.

Good work habits are as well essential in preventing product contamination. For instance, careless use of high-pressure hoses can lead to aerosols or splash that can contaminate equipment and product. Also inappropriate handling of chemicals, raw milk, and post-pasteurization ingredients could lead to product contamination.

The plant and equipment must be designed to minimize poor practices while encouraging good practices. As well, personnel must be adequately trained to ensure that procedures for equipment and product handling, clean up, and personnel hygiene are properly performed.

4. Pest Control:

Insects or rodents present in the dairy plant can lead to contamination of finished products. This can be caused by deposition of pest feces, transfer of raw product to pasteurized product via the pests, etc. As such an adequate pest control program must be in place not only for eliminating pests from the dairy plant, but also for excluding them as well.

5. Cross-Connection Control:

Cross-connections have been known to cause food poisoning outbreaks in dairy plants. Valves, check valves, etc. cannot be relied upon to separate pasteurized from raw product or CIP systems. Because of the extreme vulnerability of pasteurized product, an ongoing program must be in place to ensure no cross connections exist in the dairy plant.

6. Ingredients Listing - Allergen Control:

A significant proportion of the general population is allergic to a wide variety of ingredients and products. In some instances, consumption of even minute amounts of allergenic substance can result in the death of the individual. As such, all ingredients used must be listed on the package label in accordance with legislation.

## *B. PREVENTABLE FOODBORNE DISEASE OUTBREAKS – DAIRY PRODUCTS*

| Product Type | Year | Cause of Outbreaks | Number of Illnesses | Number of Deaths | Contaminant |
|---|---|---|---|---|---|
| Pasteurized chocolate milk | 1976 | Unsanitary addition of post-pasteurization ingredients. | 200 | 0 | Yersinia |
| Pasteurized milk | 1982 | Dirty cases. | 172 | 0 | Yersinia |
| Pasteurized milk | 1983 | Improper pasteurization? | 49 | 14 | Listeria |
| Pasteurized milk | 1985 | Chemical contamination | 32 | 0 | Ammonia |
| Pasteurized milk | 1985 | Cross-connection | >16000 | 7 | Salmonella |
| Pasteurized milk | 1990 | Excessive Vitamin D (1000x too much) | 8 | 1 | Toxic levels of Vitamin D |
| Cheese | | | | | |
| • cheddar | 1984 | Improper HTST interwiring | >1500 | 0 | Salmonella |
| • Mexican-style | 1985 | Contaminated environment | 181 | 65 | Listeria |
| • soft ripened | 1987 | Contaminated brushes, wooden hoops and shelves | 122 | 34 | Listeria |
| • soft mould/smear ripened | 2002 | Contaminated culture solutions | 42 | 2 | Listeria |
| • soft mould ripened | 2002 | Contaminated water supply | 86 | 0 | Listeria |
| • Mexican-style | 1992 | Cross-connection | 2 | 0 | Listeria |
| Yogurt | 1989 | Contaminated fruit puree | 27 | 1 | C. botulinum |
| Yogurt | 1991 | Environmental contamination Improper pasteurization? | 16 | 0 | E. coli O157 |

## REFERENCES

1. A Study Guide for the Implementation of HACCP, Ecolab Incorporated, 1992.

2. Code of Good Practice for High Temperature Short Time Pasteurizers (HTSTs), Public Health Protection Branch Publication, British Columbia Ministry of Health, 1991.

3. Dairy Handbook, Alfa - Laval AB.

4. Modern Microbiological Methods for Dairy Products, International Dairy Foundation, 1989.

5. Procedures to Implement the Hazard Analysis Critical Control Point System, International Association of Milk, Food, and Environmental Sanitarians, Inc. 1991.

6. Residues and Contaminants in Milk and Milk Products, International Dairy Foundation, 1991.

7. The Hazard Analysis and Critical Control Point (HACCP) System, Abstracts of the IFT Continuing Education Short Course, 1991.