

APPLE CIDER PROCESSING OPERATIONS REQUIREMENTS AND GUIDELINES

An Association of Food and Drug Officials
Model Code



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2nd Printing
February 2003

INTRODUCTION

In recent years, fresh or unpasteurized apple cider has been linked to numerous foodborne illness outbreaks in the United States. It is a scientifically proven fact that pasteurization, or an equivalent process, will eliminate foodborne pathogens from apple cider and thus ensure the safety of the product. Many producers of apple cider incorporate pasteurization, or other pathogen elimination procedures into their processes; consequently, much of the apple cider available to consumers is considered pasteurized, and causes little concern with respect to the presence of foodborne pathogens.

There is a segment of the apple cider industry that believes that pasteurization contributes undesirable characteristics to the product, and that consumers should have the right to choose between unpasteurized and pasteurized products. As a result, these guidelines have been developed to assist those producers in producing a product where the risk of contamination by foodborne pathogens has been significantly reduced.

The Food Committee of the Association of Food and Drug Officials under the guidance of Doug Saunders, Virginia Department of Agriculture and Consumer Services, developed these guidelines. Substantial input into the development of these guidelines was provided by both industry and government officials. The original basis for these guidelines was obtained from documents developed by the New York Department of Agriculture and Markets and the Michigan Department of Agriculture.

REQUIREMENTS AND RECOMMENDATIONS FOR APPLE CIDER PROCESSING OPERATIONS

AN AFDO MODEL CODE

May 26, 1999

Because fresh or unpasteurized apple cider has been linked to numerous foodborne illness outbreaks, the Association of Food and Drug Officials believes that pasteurization, or an equivalent process, is the only scientifically valid way to ensure the safety of apple cider. Since it may be unreasonable to expect that all apple cider processors will choose to pasteurize their products, the following requirements and recommendations for apple cider processing operations have been developed to significantly reduce the possibility that apple cider will be involved in future foodborne illness outbreaks.

Definitions

Dropped Apples: Apples that have contacted the ground in any manner in the orchard, storage cooler, pressing room or any other area. Where prudent precautions have not been taken to maintain separation of tree-picked and dropped apples, all apples shall be considered to be dropped apples.

Must:
Pasteurized: Term used to state mandatory requirements. Apple cider which has been produced by a method that includes a processing step (typically a heat process) which has been shown to effectively reduce the pathogenic microbial population in the resulting product to a level that does not contribute to foodborne illness.

Nothing contained in this definition shall be construed as barring any other process as may be demonstrated to be equally effective.

Shall: Term used to state mandatory requirements.

Should: Term used to state recommended or advisory procedures or identify recommended equipment.

Tree-Picked Apples: Apples which have been picked directly from the tree and segregated under sanitary conditions from dropped apples.

Unpasteurized: Apple cider which has been produced by methods that do not include a heat processing step which has been shown to reduce the pathogenic microbial population of the resulting product to a level that does not contribute to foodborne illness.

General

The use of a Hazard Analysis Critical Control Point (HACCP) program is strongly recommended.

Facility Requirements

Cider processing and other food-processing operations must be located in a separate, enclosed room or building. The food processing room must have impervious walls and ceilings, and the floors must be continuous concrete or other equally impervious and cleanable material with adequate floor drains.

Walls and ceilings should be light colored for easier cleaning and to provide better lighting on all work surfaces.

The processing facility must be adequately screened to eliminate insect and rodent entry. Cold storage door plastic curtains are effective where entrance is by forklift. During the cider-processing season, overhead garage door openings can be framed in with temporary screened panels and a walk-in door provided. Temporary screens should be constructed in a manner, which allows the garage doors to be closed whenever desired.

Completely enclosed toilet facilities must be provided and should be conveniently located near the work area. The lavatory must have hot and cold running water and soap for hand washing. In addition, there must be a suitable hand drying device or disposable towels and covered trash containers. A sign must be placed in the bathroom reminding employees to wash their hands after using the lavatory.

Adequate lighting must be provided. All lights over exposed food areas must be shielded to prevent pieces of glass from getting into food in the event of bulb or tube breakage.

Grounds and buildings surrounding the cider operation must be free of conditions, which may result in contamination of the product. This includes improperly stored equipment or spray materials, litter, waste, uncut weeds and grass and other rodent or pest harborage.

Disposal of all wash and wastewater shall be through an approved sanitary sewage disposal system that is sized, constructed, maintained and operated according to law.

Equipment, utensils, chemicals and supplies not used in food processing must be stored in an area clearly separated from those used in food processing.

Cleaning chemicals, such as Clean-in-Place (CIP) chemicals, must be stored separately from pesticides or other non-processing chemicals.

Hot and cold potable, running water must be available in all processing areas. Sufficient volume and water pressure must be available to dislodge particles of fruit and film from all surfaces. A high-pressure washer is highly recommended.

If well water is used, it must be tested by a certified lab at least annually to meet potability standards. The test should be done within two months prior to the commencement of seasonal apple cider operations.

The use of insecticides and rodenticides is permitted only under such precautions and restrictions as will prevent the contamination of food or packaging material with illegal residues. If used within the processing area, precautions must be taken to protect all raw ingredients and packaging materials. After spraying and before commencement of any food processing operation, all food contact surfaces must be thoroughly cleaned and sanitized.

Equipment

All food contact surfaces must be constructed of food-grade materials which are safe, durable, corrosion-resistant, non-absorbent and can be easily cleaned and sanitized. Copper, copper alloys and galvanized metals must not be used in contact with apple cider.

All food contact equipment and supplies (examples: racks, cloths) must be stored off the floor in a well-ventilated location, which minimizes the potential for contamination.

All tubing carrying cider must be approved for food use and all plastic tubing should be transparent. Tubing must be protected from abrasion or breakage and easily replaced. If the tubing passes through spaces that are not readily accessible, the tubing should be one piece and easily cleaned. Tubing should be as continuous as possible with couplings kept to a minimum. Periodic disassembling, cleaning and sanitizing of tubing, clamps, couplings and connections must be performed. Tubing must be positioned so that no pockets of liquid remain when the tubing is rinsed (self-draining). Tubing must be

cleaned and sanitized at least after each day's run and prior to use following extended interruption.

Employees

Competent supervisory personnel must be assigned the responsibility of supervising the overall sanitation of the facility.

To prevent contamination of food products, all persons working in the processing and filling areas must wear clean outer garments, maintain a high degree of personal cleanliness and conform to hygienic practices while on duty. Hands must be washed thoroughly before starting work, after each absence from the working area, between operations and any other time when they have become soiled. All insecure jewelry shall be removed. Hair restraints (hairnets, headbands, caps, etc.) must be worn. If gloves are used, they must be designed for food handling operations. Whenever personnel change from non-food contact or cleaning operation to food contact operation, the individual must replace gloves or wash hands thoroughly before resuming food contact operations.

Tobacco in any form must not be used in rooms where food or food ingredients are processed, handled or stored.

A person who has diarrhea or is a carrier of a communicable disease that can be transmitted by food is prohibited from working with cider apples or in the processing area.

Harvesting

Steps can be taken in the orchard to minimize microbial contamination of apples. Where possible, orchards should be fenced in order to restrict or eliminate animal grazing in the orchard. If orchards are frequented by large flocks of starlings or other roosting birds, soiled fruit should not be used in unpasteurized cider. Care should be taken during collection to prevent the contact of damaged apples with wholesome fruit.

Eliminate to the extent possible animal droppings and manure in the orchard. Unpasteurized apple cider must not be made from apples of orchards fertilized with human or animal wastes.

Dropped apples must not be used for the production of unpasteurized cider.

Good hygienic practices should be used by those collecting apples and toilet and hand washing facilities should be readily accessible to field workers.

Know the quality of the apples from which you will be making your cider. More contaminated apples coming into your process will require more stringent inspection and cleaning to make safe cider. The use of written contract specifications is highly recommended for cider producers who purchase cider apples.

Clean containers must be used to harvest and transport apples. Containers should be properly maintained and inspected continually throughout the season.

Receiving

If cider apples are purchased, accurate records should be kept of incoming lots, which identify the date of purchase and source of apples used to produce each lot of cider. Accurate records can limit product recalls and producer liability in the event of an outbreak.

Processing apples should be kept in cold storage, as close to 32°F as possible, or in an enclosed area, free of flies, other insects, rodents and other pests. Lower temperatures extend product shelf life considerably.

Animals (cats, birds, dogs, wild animals, etc.) are prohibited from processing and storage areas of the building.

Apple containers should be inspected upon receipt and before apples are used to assure the containers are free of visible filth which may contaminate the apples.

Inspection

All apples must be inspected before or during washing and brushing. Only intact, sound apples shall be used. Wormy, decayed or rotten fruit must be discarded before entering the washing step. Only intact, sound tree-picked fruit shall be used in the production of unpasteurized apple cider. Damaged fruit (i.e., hail damage, etc.) may be used as long as such damage does not negatively impact the microbiological

quality of the fruit. Otherwise, damaged fruit must be discarded before entering the washing step.

Fruit should be dry-dumped for inspection to prevent heavily soiled apples from spreading contamination via wash water.

If a flume is used, flume water must be of potable quality. Additionally, potable water or its equivalent must be used as a final rinse prior to pressing.

If field crates are floated in flume water, pressure washing the bottoms of crates before submerging them in flume water is recommended.

Washing and Brushing

Apples must be thoroughly washed and cleaned (free of visible filth and debris) before crushing. This can be accomplished as part of the grading operation if there is no storage or holding time between grading and pressing.

Use of a food grade detergent and sanitizer in accordance with the manufacturer's label specifications to further reduce biological contamination is recommended.

Crushing and Pressing

Crushing and pressing equipment must be cleaned prior to start-up and cleaned and sanitized at the end of each day of operation at a minimum.

Equipment must be dismantled or disassembled at least daily to insure adequate cleaning and sanitizing. Do not rinse equipment after sanitizing. All equipment must be air-dried.

Press cloths must be specifically designed for cider production, made of durable materials and be replaced frequently. During processing, the cloths must be handled in a sanitary manner, which includes hanging the cloths on a line or placing them in a clean container off the floor between runs. At the end of each day's operation, all press cloths must be washed, rinsed, dipped in sanitizing solution and dried. The cloths may be dried by spreading them on a clean line in a well-ventilated and screened area away from flies and vermin. If a washing machine is

used, it must be dedicated solely for the cloths and not for personal and work clothing.

Press racks must be made of food-grade plastic or hardwood which has been maintained free of excessive cracks or crevices. Poorly maintained equipment can be impossible to clean and sanitize adequately.

Keep press racks off the floor at all times. At the end of each day, all used press racks must be washed, sanitized and allowed to dry.

Pressed pomace must be properly disposed of immediately. Pomace residue must not be left overnight in the processing area. Pomace residue removal helps control insects and rodents on the property.

Processing Options

If additives (e.g., sodium benzoate and potassium sorbate) are used, care must be taken to assure they are used in accordance with good manufacturing practices and as specified in Title 21 of the Code of Federal Regulations. Studies have shown a combination of both additives at 0.1% each to be most effective in controlling *E.coli* 0157:H7.

Fresh cider is typically not pasteurized, but recent data has shown that heating cider for only 6 seconds at 160°F eliminates *E. coli* contamination.

After Pressing

Thermal or ultraviolet pasteurization is recommended as is the use of microbiological testing procedures on production batches to identify sanitation failures or product contamination. In order to guarantee that the pasteurization equipment you plan to purchase, or have already purchased, incorporates those design features necessary to insure your cider has been properly pasteurized, it is recommended that you submit a schematic of the pasteurizer to the regulatory authority for review (see addendum titled "Apple Cider - Thermal Pasteurization Equipment Recommendations"). While end product testing may not be a complete assurance that the cider is free of pathogens, indicator organisms such as coliforms or generic *E coli* may help determine if adequate and consistent sanitation is being practiced. Testing may also play a role in HACCP plan verification and establishes a quality history.

Cider must be bottled in new containers and caps which have been properly stored to be free of dust, debris and insects. Containers must be stored in their original closed plastic bags and inverted with the open tops down to avoid environmental contamination. Inspect containers carefully before filling, and/or sanitize them thoroughly. Refilling used consumer containers risks contamination of filling equipment and cider and can take place only in a manner approved by the regulatory authority.

Labeling

Containers must be properly labeled with the following information:

- Product identity -- Apple Cider
- Ingredients (if additives are used)
- Name, address, city, state and zip code of manufacturer, packer or distributor
- Net quantity

Nutritional labeling, as identified in Title 21, Part 101 of the Code of Federal Regulations (21 CFR 101), may also be required.

The statement, "**IMPORTANT, Must be Kept Refrigerated,**" should appear on the label as well as meaningful coding which identifies the packing period.

In most cases, federal regulations require warning statements on labels of packaged juice products that have not been processed in a manner that will produce a reduction in pathogenic microorganisms to an acceptable level. The required warning statement, identified in 21 CFR 101.17 (g), reads as follows:

WARNING: This product has not been pasteurized and, therefore, may contain harmful bacteria that can cause serious illness in children, the elderly, and persons with weakened immune systems.

Those operators who produce apple cider that has not been processed in a manner that will produce a reduction in pathogenic microorganism to an acceptable level, but do not fall within the requirements of 21 CFR 101.17 (g), are encouraged to implement such a labeling program to inform at-risk consumers of the hazards that may be associated with such products.

Off-season

During the off-season, press racks and cloths should be stored so that birds, animals, insects, etc., are unable to come in contact with them. Thoroughly clean, sanitize, dry, and wrap racks and cloths before storage.

While none of the foregoing requirements and recommendations can guarantee pathogen-free cider, their implementation will serve to greatly reduce the possibility that your cider will be involved in a foodborne disease outbreak.

These guidelines are based on currently available scientific information and will be revised and updated as researchers learn more about pathogens of concern in cider and their control.

ADDENDUM TO REQUIREMENTS AND RECOMMENDATIONS FOR APPLE CIDER PROCESSING

Apple Cider Thermal Pasteurization Equipment Recommendations

May 26, 1999

Currently available scientific information suggests that adequate pasteurization for apple cider produced from most varieties of apples is achieved at a temperature of 160°F for 6 seconds. An exception to this is cider produced from "*Red Delicious*" apples which requires a temperature of 160°F for 11 seconds or 170°F for 2 seconds.

Consumers and apple cider processors alike should have confidence that cider which is labeled pasteurized has in fact undergone an adequate pasteurization process. We believe that compliance with the following apple cider pasteurization equipment recommendations can help provide reasonable assurance that your cider has been properly pasteurized.

I. RECORDER CONTROLLER

- A. Purpose: To automatically record pasteurization temperatures and times and automatically control the position of the flow diversion device.
- B. Location: The sensor should be located within 18 inches of and upstream from the flow diversion device.
- C. Design and Operation: The recorder controller or Safety Thermal Limit Recorder (STLR) is an electronic instrument actuated by either a Bourdon coil attached to an ether derivative (water and glycerin) filled capillary which responds to temperature changes or may be one of the newer type electronic programmable recorder controllers which utilize electronic remote temperature sensing devices and computer logic.

II. INDICATING THERMOMETER

A. Purpose: To indicate the accurate temperature of the product.

B. Location: At the end of the holding tube and as close as practicable to the recording thermometer sensor.

C. Specifications:

1. Type:

a. Mercury In Glass (MIG) - Mercury actuated, direct reading, corrosion resistant case.

(1) Scale: Span not less than 25°F including pasteurization temperature plus or minus 5°F, graduated in 1.0°F divisions.

(2) Accuracy: Tested against known standard upon installation and then at least once a year thereafter.

(3) Thermometric response: 4 seconds to travel 63% (12° which includes the pasteurization range) of a 19° span.

b. Digital Reference Thermometer (DRT) - On November 27, 1991, the FDA, through M-b-314, allowed the use of the digital reference thermometer (DRT) as a replacement for the mercury actuated (MIG) indicating thermometer for use in pasteurization systems.

(1) Scale: Temperature indicated to at least 0.1°F.

(2) Accuracy: Tested against known standard upon installation and then at least once a year thereafter.

(3) Thermometric response: 4 seconds to travel 63% (12° which includes the pasteurization range) of a 19° span.

III. HOLDING TUBE

- A. Purpose: Section of piping of sufficient length to provide a minimum holding time at a predetermined temperature for heated product in a continuous flow pasteurizer.
- B. Design and Operation:
1. Permanent supports to assure alignment and proper slope to preclude air entrapment and assure uniform product flow. The minimum upward slope is 0.25 inch per running foot, or 2.1 centimeters per meter.
 2. Fabricated to eliminate short circuiting (no alterable sections).
 3. Starts at the salt injection port and ends at the flow diversion device.
 4. Designed to assure temperature variation not to exceed 1°F.
 5. Heat should not be applied to the holding tube at any point.

IV. TIMING (METERING) PUMP

- A. Location: In basic High Temperature Short Time (HTST) systems, the conventional timing pump will be the only flow promoting device in the system. Timing pumps, when used in systems with product-to-product regenerators, should always be placed downstream from the raw regenerator. This is to assure that during operation, raw product pressures in the product-to-product regenerator are relatively less than pressures on the pasteurized side of the plates. Timing pumps may be speed adjustable but are always set at the fastest minimum legal pasteurization time(s) and sealed to prevent unauthorized changes. Some timing pumps are electronically controlled, and this controller should also be sealed to prevent unauthorized changes. Timing pumps may operate at any time except when the dual stem flow diversion device mode switch is in the "**Inspect**" position or unless during the diverted flow,

the flow diversion device is properly assembled and the microswitch is in the proper position.

B. Types:

1. Positive displacement type: Positive pumps may be of several types, two of which are in common usage in the continuous flow pasteurizer.
 - a. Gear driven type pump (where two rotors or impellers revolve within an oval case). Close tolerances between the gears and the outer case make the space or pockets between the teeth or lobes carry the fluid around the periphery of the pump body. The size of these pockets and the speed at which they revolve determine the volume that will be pumped. It is important to remember that the efficiency of these impeller-type pumps may be greatly influenced by the temperature and type of liquid they are pumping. This becomes important when performing the holding time test for systems with these types of pumps.
 - b. Belt/pulley driven piston type pump such as the homogenizer. Homogenizers are very efficient positive displacement pumps and are frequently used as the timing pump in continuous pasteurizers.
2. Magnetic flow meter based system which uses a centrifugal pump in conjunction with product flow controlling methods.
3. Centrifugal Pumps.

C. Controls:

1. The timing pump should be considered operating at maximum speed and capacity to assure that the minimum holding time requirements are satisfied.
2. The pump should also be interwired with the flow diversion device and recorder controller. This is to

prevent the flow of raw product into the pasteurized side of the system.

3. Generally, there is only one primary timing device in the system. When two positive displacement pumps are used as timing pumps, both should be timed separately and together to assure minimum holding times are achieved.

V. FLOW DIVERSION DEVICE (FDD)

High Temperature Short Time (HTST) continuous flow pasteurization equipment should be equipped with either a single or dual stem FDD.

A. Single Stem:

1. Purpose: To safely and accurately control and separate raw and pasteurized product flow.

The single stem flow diversion device is a specially designed three-way valve that, in conjunction with a recorder controller, is capable of automatically controlling the direction of product flow in a pasteurizing system. It should be manually cleaned.

2. Operation:

- a. The single stem flow diversion device is air activated for the open position (forward flow) and spring activated for the closed (divert or fail-safe) position. To activate (open) the valve, compressed air is admitted above the diaphragm. This compresses the spring and moves the valve to seal off the divert line and opens the forward flow port. Compressed air to the top of the diaphragm is controlled through an air-activated solenoid valve. This solenoid is activated by a signal from the recorder controller microswitch when the preset cut-in temperature is reached. Loss of air pressure or electrical signal from the recorder controller causes the spring to

automatically return the valve to the closed or fail-safe divert position.

- b. When the flow diversion device is properly assembled and in the fully diverted position, the microswitch roller will be positioned in the valve diaphragm push plate groove. In this position, the microswitch provides power to the timing pump and the red light on the recorder controller.
- c. When the flow diversion device is in the forward flow position, the roller rides above the groove and the microswitch energizes the green light and the frequency pen arm on the recorder controller. During legal forward flow, the timing pump is energized by the recorder controller switch.
- d. If during diverted flow the diversion device is not properly assembled or seated, the microswitch roller will be mispositioned out of the groove and the timing pump will not run. This prohibits any raw product from entering the forward flow port of the valve during divert.

3. Basic Requirements:

- a. Systems should be provided to insure proper operation of the FDD to operate only when properly assembled and then only when in the fully forward or fully diverted position.
- b. It should be impossible to tighten the stem packing nut so as to prevent the valve from assuming the fully diverted position within the prescribed time (1 sec.).
- c. Leak escape ports should be unobstructed and on the forward flow side of the flow diversion device seat. The forward flow seat should close tight enough so that any leakage past the seat will not exceed the capacity of the leak escape device. The poppet valves, as they are known, are held in place by springs and "O rings." When the valve is in diverted flow, the leak detectors allow product

which leaks past the sealing rings (gaskets) of the valve plunger to escape to the atmosphere. In forward flow the springs hold these poppets against their seat preventing leakage. Product pressures in excess of 20 psi may prevent their proper seating and result in leakage.

- d. The length of the connecting rod should not be adjustable. Power failure or loss of air pressure should automatically move the valve to the fail-safe (*diverted*) position. The flow diversion device should be located downstream from the holding tube. The divert line should be self-draining and should be free of restrictions or valves unless readily identifiable and are so designed that stoppage of the divert line cannot occur.

B. **Dual Stem:**

1. Purpose:

- a. To safely and accurately control and separate raw and pasteurized product flow.
- b. A dual stem flow diversion device is basically two, three-way valves in tandem which automatically control the direction of product flow. This type of valve or device was designed to be cleaned in-place.

2. Operation:

- a. Each manufactured brand of valve is slightly different in design, however, all have two bodies with an interconnecting yoke, pneumatic actuators and spring-loaded valve plungers.
- b. All are designed to move to, or remain at, the fail safe divert position in the event of loss of power or air pressure.
- c. Each valve is actuated by a quick exhaust type solenoid valve that controls the air to each valve.

- d. Microswitches (or proximity switches on some models) are located near the top of each actuator stem in the valve bonnet, and operate and function identical to those in the single stem flow diversion device. (Control power signal to the timing pump, frequency pen and panel indicator lights).

3. Basic Requirements:

- a. Systems should be designed to insure proper operation of the flow diversion device only when properly assembled and only when in the fully forward or fully diverted position.
- b. It must be impossible to tighten the stem packing so as to prevent the valve from assuming the fully diverted position within the prescribed time (< 1 sec.).
- c. Leak escape ports must be unobstructed and on the forward flow side of the flow diversion device seat. The forward flow seat should close tight enough so that any leakage past the seat will not exceed the capacity of the leak escape device. This requirement design should eliminate any back pressure from being applied to the divert and leak detect ports of the flow diversion device.
- d. The length of the connecting rod should not be adjustable.
- e. Power failure or loss of air pressure should automatically move the valve to the fail-safe (diverted) position.
- f. The flow diversion device should be located downstream from the holding tube.
- g. The divert line should be self-draining and should be free of restrictions or valves unless readily identifiable and are so designed that stoppage of the divert line cannot occur.

- h. The leak detect line should be designed to discharge all leakage to the outside or to the constant level tank. This leak detect line must be separate from the divert line and should not have any restrictions.

A sight glass must be installed in the leak detect line if connected to the constant level tank. This sight glass must be of the full see-through (clear material providing vision on both sides of the cross fitting) design and be installed in the vertical line.

The only exception to this requirement is the provision for a transparent tube assembly which may be installed horizontally.

- i. All dual stem valves which have both bodies mounted vertically must have the sealed time delays. There is a newer model of the G&H FDD that because of the connecting "yoke" configuration is exempt from this requirement. These time delays are as follows:

- (1) At least one second between actuation of the divert valve and the leak detect valve when moving from the diverted flow to the forward flow position. The purpose of this is to flush the connecting line of any possible raw product remaining in this connecting "yoke." On systems having identifiable restrictors in the divert line, the maximum time delay (divert valve to leak detect valve "flush time") should never exceed five seconds which prevents the possibility of underprocessed product (< 15 seconds) from entering into the pasteurized side of the system.

- (2) When the switch is moved from "**PRODUCT**" or "**PROCESS**" to the "**INSPECT**" position, the valve should immediately assume the "**DIVERT**" position and all flow promoting devices should be immediately de-energized. After all flow promoting devices have

completely stopped (or have been effectively valved out of the system) the flow diversion device may move to the "**FORWARD FLOW**" position for inspection or servicing.

- (3) A maximum of one second time delay is allowed during transition movement times of the flow diversion device provided that a one second maximum "off" time delay is allowable to maintain the flow promoting device in the "on" position through the travel time of the valve(s) (NCIMS-93). This removes the requirement for de-energizing the flow promoters (i.e., timing pumps) during times required for the flow diversion device to move to the forward or divert flow position.

VI. REGENERATOR PRESSURE RELATIONSHIPS

- A. Purpose: Pasteurized and raw products are separated by only thin stainless steel plates and a series of gaskets in the regenerator section. That is the reason that the pasteurized product **SHOULD ALWAYS** be under greater pressure than the raw product in the system. In the event of leakage due to either gasket or metal failure, the pasteurized product will be forced into the raw side of the regenerator and not vice versa.
- B. Operation: This pressure relationship should always be maintained during all phases of operations. This includes initial start-up, during processing (including diverted flow), and during any periods of sudden loss of power or shutdown.
- C. Basic Requirements:
 1. The overflow level of the balance tank should be lower than the product level within the regenerator.
 2. The timing pump should be located between the outlet of the raw regenerator and the beginning of the holding tube.

3. No pump, other than a properly designed, installed and operated booster pump, should be installed between the balance tank and the raw product inlet to the regenerator.
4. Generally, the product should enter the raw side of the regenerator at the bottom, unless the system has a start-up regenerator bypass line, properly valved to allow unobstructed drainage of raw product back to the balance tank during loss of power or shutdown.
5. Pasteurized product at the outlet from the pasteurized regenerator should rise to a vertical elevation of at least 12 inches above the highest raw product in the pasteurizer system and at that point or higher should be open to the atmosphere through a sanitary vacuum breaker.
6. No flow promoting device which can affect the pressure relationships within the regenerator may be located between the pasteurized product outlet of the regenerator and the vacuum breaker.
7. During shutdown or loss of power, the vacuum breaker closes off the product line resulting from atmospheric pressure being applied on the breaker disc. This produces a capillary-type action holding the pasteurized product with the 12-inch rise of piping which produces a back pressure on the pasteurized side of the product-to-product regenerator to approximately 1 psi. The pasteurized product is simultaneously held in a static position by the forward flow valve seat of the flow diversion device, which prohibits any back drainage into the holding tube. During this time, the raw product is undergoing a pressure reduction which is facilitated through the small drilled holes in the raw product deflector plates located at or near the bottom of the plate. To facilitate this, the outlet to the raw product regenerator may be disconnected.

VII. All frequency controllers, if used, should be set at 60 Hz during pasteurization cycle. Clean-in-Place (*CIP*) function is exempt from this requirement.

