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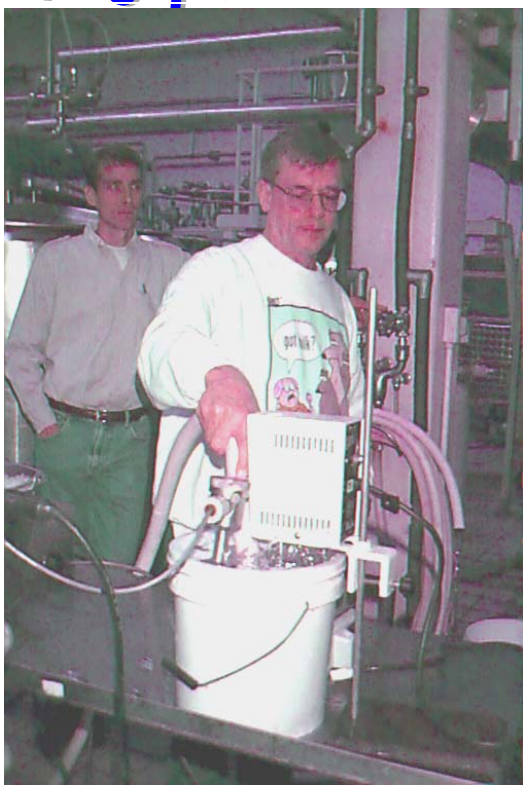
Chapter VIII

Pasteurization System Testing



PASTEURIZATION EQUIPMENT CONTROLS AND TESTS

I. TESTING APPARATUS SPECIFICATIONS

TEST THERMOMETER

Type.--Mercury-actuated; readily cleanable; plain front, enameled back; length 305 m

Scale Range.--At least 7° C (12°F) below and 7° C (12°F) above the pasteurization temperature at which the operating thermometer is used, with extensions of scale on either side permitted, protected against damage at 149° C (300°F).

Temperature Represented by Smallest Scale Division.--0.1° C (0.2°F).

Number of Degrees per 25 millimeters (Inch) of Scale.--Not more than 4 Celsius deg

Accuracy.--Within 0.1° C (0.2°F) plus or minus, throughout specified scale range. The accuracy shall be checked against a thermometer which has been tested by the National Bureau of Standards.

Bulb.--Corning normal or equally suitable thermometric glass.

Case.--Suitable to provide protection during transit and periods when not in use.

GENERAL PURPOSE THERMOMETER

Type.--Pocket type.

Scale Range.---1°C (30°F) to 100°C (212°F), with extension on either side permitted. Protected against damage at 105°C (220°F).

Temperature Represented by Smallest Scale Division.--I°C (2°F).

Accuracy.--Within 1°C (2°F) plus or minus, throughout the specified scale range. Checked periodically against a known accurate thermometer.

In the case of mercury actuated general purpose thermometers, the following additional specifications shall apply:

Magnification of Mercury Column.--To apparent width of not less than 1.6 millimet

Number of Degrees per Inch of Scale.--Not more than 29 Celsius degrees or not more than 52 Fahrenheit degrees.

Case.--Metal, provided with a fountain pen clip.

Bulb.--Corning normal or equally suitable thermometric glass.

ELECTRICAL CONDUCTIVITY MEASURING DEVICES

Type.-; Manual or automatic.

Conductivity.--Capable of detecting change produced by the addition of 10 ppm of sodium chloride, in water of 100 ppm of hardness. Other equivalent chemical solutions may also be used as desired.

Electrodes.--Standard.

Automatic Instruments.--Electric clock, time divisions not less than 0.2 of a second.

STOPWATCH

Type.--Open face,electronic or mechanical indicating fractional seconds.

Accuracy.--Accurate to 0.2 of a second.

Scale.- Divisions of not over 0.2 of a second.

Crown.--Depression of crown (or push buttons) starts, stops, and resets to zero. (Digital stopwatches operated as instructions prescribe).

II. TEST PROCEDURES

Equipment and field tests to be performed by the regulatory agency are listed and suitably referenced below. The results of these tests shall be recorded on suitable forms and filed as the regulatory agency shall direct.

<u>On an emergency basis, the pasteurization equipment may be tested and temporarily sealed by a dairy plant employee provided the following conditions are met:((NCIMS-1993)).</u>

a. The individual applying the seal(s) is employed in a supervisory capacity by the plant in which the seal was removed.

b. The individual has satisfactorily completed a course of instruction, acceptable to the regulatory agency, on tests controls for pasteurization equipment that includes a minimum of 8 hours classroom instruction, and

c. The individual has demonstrated the ability to satisfactorily conduct all pasteurization control tests, in the presence of a regulatory official within the past year; and

d. The individual is in possession of authorization from the regulatory agency to perform these tests; and

e. The individual will immediately notify the regulatory agency of the time of the shutdown that would necessitate the removal of the regulatory seals. Permission to test (and seal) the equipment must be obtained for each specific incident. The individual will also notify the regulatory agency of the identity of the controls affected, the cause(if known) of the equipment failure, the repairs made and the result of testing (when completed). The individual will provide the identity and volume of products processed during the period that temporary seals were applied to the regulatory agency; and

f. If regulatory tests reveal that equipment or controls are not in compliance with the provisions of this document, all products that were processed during that period will be recalled; and

g. The regulatory agency will remove the temporary seals, retest the equipment and apply seals within 3 working days of notification by industry; and

h. No Grade A dairy products will be processed after three working days without the affected equipment being tested and sealed by the regulatory agency.

II. TEST PROCEDURES

TEST 1
INDICATING THERMOMETERS--
TEMPERATURE ACCURACY

Reference.--Item 16p(E).

Application.--To all indicating thermometers used for the measurement of product temperature during pasteurization or aseptic processing, including airspace thermometers.

Frequency.--Upon installation and once each 3 months thereafter or whenever the thermometer has been replaced or the regulatory seal on a digital sensor or the digital control box has been broken.

Criteria.--Within 0.25°C (0.5°F) for pasteurization and aseptic processing thermometers and 0.5°C (1°F) for airspace thermometers plus or minus, in a specified scale range. Provided, that on batch pasteurizers used solely for 30 minute pasteurization of products at temperatures above 71°C (160°F), indicating thermometers shall be accurate to within 0.5°C (1°F) plus or minus.

Apparatus.--

1. Test thermometer meeting specifications under Appendix I, Part 1. Provided that types other than mercury actuated may be used when they have been 1) recognized by the Food and Drug Administration to be equally fail safe, accurate, reliable and meet the scale and thermometric response specifications and 2) which are approved by the regulatory agency.

2. Water or oil bath, or other suitable heating media to within a range of 2°C (3°F) of the appropriate pasteurization or airspace temperature, or aseptic processing temperature.

3. Suitable means of heating the water or oil bath.

Method--Both thermometers exposed to a water or oil medium of uniform temperature. Indicating thermometer reading is compared to the reading of the test thermometer.

Procedure:

1. Prepare a quantity of water in a milk can or a quantity of oil in an oil bath, or a quantiy of other suitable heating media, by raising the temperature of the water or oil or other suitable heating media to within a range of 2°C (3°F) of the appropriate pasteurization or aseptic processing temperature or airspace temperature.

2. Stabilize the bath temperature and agitate the water or oil bath rapidly.

3. Continuing agitation, insert the indicating and test thermometers to indicated immersion point.

4. Compare both thermometer readings at the appropriate pasteurization or aseptic processing temperature within the test range.

5. Repeat comparison of readings.

6. Record thermometer readings, thermometer identification, or location.

7. Install seals as appropriate on sensors and control boxes of digital thermometers. Record identity of Indicating Thermometers used in Aseptic Processing Systems.

Corrective Action.--Do not run the test if the mercury column has been split or the capillary tube is broken. Broken thermometers should be returned to the factory for repair. When the indicating thermometer differs from the test thermometer by more than 0.25°C (0.5°F) and the airspace thermometer by more than 0.5°C (1°F), the indicating thermometer should be adjusted to agree with the test thermometer. Retest the thermometer after adjustment. Note: Electronic digital read out thermometers not meeting the above criteria shall be repaired, adjusted, or replaced as recommended by the applicable manufacturer.

TEST 2
RECORDING THERMOMETERS--TEMPERATURE ACCURACY.

Reference--Item 16p(E).

Application--To all recording and recorder/controller thermometers used to record milk temperatures during pasteurization or aseptic processing.

Frequency.--Upon installation, at least once each 3 months and whenever recording pen-arm setting requires frequent adjustment, when sensing element has been replaced, or when a regulatory seal has been broken.

Criteria.--Within 0.5°C (1°F) plus or minus, in specified scale range. Provided that on batch pasteurizers used solely for 30-minute pasteurization of products at temperatures above 71°C (160°F), recording thermometers shall be accurate to within 1°C (2°F), plus or minus, between 71°C and 77°C (160°F and 170°F)

Apparatus--Pasteurizer or aseptic processor indicating thermometer previously tested against a known accurate thermometer, water baths or suitable vats or containers, agitator, suitable means of heating water baths, and ice.
Note: When this test is performed on recorder/controllers used with HHST pasteurization or aseptic processing systems operating at or above the boiling point of water, an oil bath shall be substituted for the processing (operating) temperature water mentioned in steps 1,4,5,6, and 7 as well as the boiling water mentioned in steps 2, 3, and 5. The temperature of the oil bath which is used in place of the boiling water shall be above the normal operating range but below the highest temperature division on the chart.

Method--The testing of a recording thermometer for temperature accuracy involves the determination of whether or not the temperature pen-arm will return to within 0.5°C (1°F) or 1°C (2°F) as provided above, of its previous setting after exposure to high heat and melting ice.

Procedure.

1. Adjust the recording pen to read exactly as the previously tested indicating thermometer in the temperature range for the process being used after a stabilization period of 5 minutes (2 minutes for electronic recorder controllers) at a constant temperature. The water bath shall be rapidly agitated throughout the stabilization period.

2. Prepare one water bath by heating to the boiling point and maintain temperature. Prepare a second container with melting ice. Place water baths within working distance of the recorder sensing element.

3. Immerse the sensing element of the recorder in boiling water for not less than 5 minutes(2 minutes for electronic recorder controllers).

4. Remove the sensing element from the boiling water and immerse in ater at a temperature within the testing range for the pasteurization process being used. Allow a 5-minute(2 minutes for electronic recorder controllers) stabilization period for both indicating and recording thermometers. Compare readings of the indicating and recording thermometers. The recorder reading should be within 0.5^{o}C (1^{o}F), plus or minus, of the indicator thermometer reading.

5. Remove sensing element from bath at operating temperatures and immerse in melting ice for not less than 5 minutes(2 minutes for electronic recording controllers).

6. Remove sensing element from ice water and immerse in water at a temperature within the testing range for the process being used. Allow a 5-minute (2 minutes for electronic recorder controllers) stabilization period for both indicating and recording thermometers. Compare readings of the indicating and recording thermometers. The recorder reading should be within 0.5^{o}C (1^{o}F) plus or minus, indicator thermometer reading.

7. Re-seal regulatory controls as necessary and record indicating and recording thermometer readings at steps 1, 4 and 6.

Corrective Action.--If the pen does not return to 0.5°C (1°F) or 1°C (2°F), plus or minus of indicating thermometer reading, the recording thermometer should be repaired.

TEST 3
RECORDING THERMOMETERS--
TIME ACCURACY

Reference--Item 16p(E).

Application--To all recording and recorder/controller thermometers used to record time of pasteurization.

Frequency--Upon installation and at least once each 3 months thereafter or whenever the seal of a programmable recorder/controller has been broken.

Criteria--The recorded time of pasteurization shall not exceed the true elapsed time.

Apparatus--

1. A watch graduated at intervals not to exceed 1 minute, and accurate to within 5 minutes in 24 hours.

2. A pair of dividers, or any other suitable device for measuring short distances.

Method--Comparison of the recorded time over a period of not less than 30 minutes with a watch of known accuracy. For recorders utilizing electric clocks, check cycle on face plate of clock with a known cycle; observe that clock is in good operating condition.

Procedure.

1. Determine if chart is appropriate to recorder. Insure that the recording pen is aligned with the time arc of the chart at both the center and the outside.

2. Inscribe reference mark at the pen point on the recorder chart and record the time.

3. At the end of a minimum of 30 minutes by the watch, inscribe a second reference mark at the pen point position on the chart.

4. Determine the distance between the two reference marks and compare the distance with the time-scale divisions on the record chart at the same temperature. Use of an engineering type divider will greatly increase the accuracey of this measurement.

5. For electric clocks, remove face plate, compare cycle specification on face plate with the current cycle utilized.

6. Enter finding on chart and initial. Record results. Reseal regulatory controls as necessary.

Corrective Action--If recorded time is incorrect, the clock should be adjusted or repaired.

TEST 4
RECORDING THERMOMETERS-
CHECK AGAINST
INDICATING THERMOMETERS

Reference--Item 16p.

Application--To all recording and recording/controller thermometers used to record milk temperatures during pasteurization or aseptic processing.

Frequency--At least once each 3 months by regulatory agency; and **daily by the plant or pasteurizer/aseptic processor operator**.

Criteria--Recording thermometer shall not read higher than corresponding indicating thermometer.

Apparatus--No supplementary materials required.

Method--This test requires only that the reading of the recording thermometer be compared with that of the indicating thermometer at a time when both are exposed to a stabilized pasteurization or aseptic processing temperature.

Procedure.--

1. While the indicating and recording thermometers are stabilized at an acceptable pasteurization or aseptic processing temperature, read indicating thermometer.

2. Immediately inscribe on the recording thermometer chart a line intersecting the recorded temperature arc at the pen location: record on the chart the indicating thermometer temperature; initial.

3. Record results.

Corrective Action--If recording thermometer reads higher than indicating thermometer, the pen shall be adjusted for accuracey by the operator. Re-sealing may be necessary on some earlier models of computer programmable STLR's.

TEST 5
FLOW-DIVERSION DEVICE--
PROPER ASSEMBLY AND FUNCTION

Reference--Item 16p(E).

Application-- To all flow-diversion devices used with HTST flow pasteurization with the following exceptions. **Parts 1 through 9 do not apply to aseptic processing systems.** Parts 5 and 9 apply **only** to flow diversion devices used with HTST pasteurizers, and parts 1 to 4 and 6 to 8 apply to all flow diversion devices used with continuous flow pasteurizers.

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Frequency--Upon installation and at least once each 3 months thereafter or whenever a regulatory seal has been broken.

Criteria--The flow-diversion device shall function correctly in operating situations and **in the event of malfunction or incorrect assemply**, **shall de-energize the metering pump** and all other flow promoting devices capable of producing flow through the holding tube.

5.1 LEAKAGE PAST VALVE SEAT(S)

Apparatus--For all flow diversion devices including both single and dual stem types. Suitable tools are necessary for the dissasembly portion of this test.

Method--Observe leakage past the valve seat(s) for the single stem, or the leak detect valve piping (dual stem) of the flow-diversion device for leakage.

Procedure--With the system operating with water, place the flow-diversion device in **diverted-flow position**.

A) For Single Stem Valves, disconnect the **forward flow piping** and observe the valve seat for leakage. Check leak escape ports to see if they are open.

B) With the dual stem device, observe the **leak detect line discharge or sight glass for leakage.**

Corrective Action--If leakage is noted, device must be dismantled and defective gaskets replaced, new plugs valve stem plugs installed, or other suitable repairs made.

5.2 OPERATION OF VALVE STEM(S)

Apparatus--Suitable tools for tightening single stem packing nut. and as necessary tools for dissembly of some dual stem flow-diversion device stem's and actuators and other sanitary piping wrenches.

Method--Observe flow-diversion device valve stem(s) for ease of movement.

Procedures--When a stem packing nut is used, tighten stem packing nut as much as possible. Operate system; place device in forward and diverted flow several times. Note freedom of action of valve stem.

Corrective Action--If valve action is sluggish, suitable adjustment or repair shall be made to permit stem to act freely in all positions, with packing nut, when applicable, is fully tightened.

5.3 DEVICE ASSEMBLY, SINGLE STEM DEVICE

Apparatus--Sanitary fitting wrench and suitable tools for tightening the packing nut on the stem.

Method--During diverted flow, by temperature, observe function of metering pump and all other flow promoting devices capable of causing flow through the holding tube, when flow-diversion device is improperly assembled.

Procedures.--a. Place the flow diversion device in diverted flow either by lowering the temperature or by removing the STLR sensor from the water bath. Disconnect the forward flow piping (not the large 13H hex nut at the top of the

valve)which negates any downward force on the hex nut and with all flow promoting devices in HTST system in operation and in **diverted flow**, **unscrew by one half turn, the 13H hex nut which holds the top of the valve to the valve body.** This should de-energize the metering pump and all other flow promoting devices capable of causing flow through the holding tube.

b. With the HTST system in operation below the required process temperature**(diverted flow**), **remove the connecting key located at the base of the valve stem.** The metering pump and all other flow promoting devices should be de-energized.

Corrective Action.--If metering pump or flow promoting device fails to respond as indicated, immediate checks of the device assembly, the micro-switch, and wiring are required to locate and correct the cause.

5.4 DEVICE ASSEMBLY, DUAL STEM DEVICE

Note: 1. The test procedure presented in the section is typical of tests accepted by regulatory authorities. Testing details may vary for individual flow diversion device types are provided in the device operators manuals which hav been reviewed by FDA.

2. The word "metering pump" or "timing pump" found in the manufacturers manuals testing section shall be interpreted to include all other flow promoting devices capable of causing flow through the holding tube.

Apparatus--Suitable tools as required or recommended by the individual flow diversion type.

Method--Observe function of metering pump all other flow promoting devices capable of causing flow throughthe holding tube when the flow-diversion device is improperly assembled.

Procedures.--

a. With the device in **diverted-flow, by temperature,** when flow-diversion device is properly assembled remove the valve actuator (top) clamp.

b. Move the device to the forward-flow position and disconnect the stem from actuator. **This may be accomplished using the INSPECT mode locate on the device control panel**.

c. **Move the device to the diverted-flow position .** This may be accomplished by moving the mode switch on the control panel to the DIVERT position. **Turn on the metering pump and all other flow promoting devices**. The metering pump or other flow promoting devices should not run. If any pump starts momentarily and then stops, it may indicate improper wiring of the one second time delay as allowed in 16p.B.2.b. Separators must be effectively valved out of the system.

d. Reassemble the device by moving it to the forward-flow position and reconnecting the stem to the actuator. **This may be accomplished on some dual stem valve systems by placing the mode switch in th INSPECT position**.

e. Move the device to the diverted-flow position and replace the actuator clamp then **repeat procedure for the leak-detect device assembly**.

f. Re-seal regulatory controls as necessary.

Corrective Action.--If any flow promoting devices fail to respond as indicated, an immediate check of the device assemply and wiring is required to locate and correct the cause.

Cherry Burrell Flow Diversion Device (Models Manufactured after 1/1/83)

Device Assembly Test Procedures

1. With the system temperature at sub-legal (divert), set the FDV MODE Switch to INSPECT.

2. After the valves have assummed the **FORWARD FLOW** position, turn the air shut-off valve handle 90 degrees which traps the air and retains the valve in the Forward Flow position.

3. Set the **FDV MODE** Switch to **PROCESS** and turn on the timing pump. The timing pump **should not operate.**

4. Set the **FDV MODE** Switch to **OFF**. Slowly open the actuator air Shut-Off valve until the piston rod moves very slightly (about 1/4 inch), then close the Shut-Off valve.

5. Using two open-end wrenches, unscrew the valve stem from the piston rod (about 1/8 inch). Slowly open the Shut-Off valve again allowing the valve to assume the **DIVERT** position.

6. Set the FDV MODE Switch to PROCESS and turn the timing pump on. **The TIMING PUMP OR OTHER FLOW PROMOTING DEVICES SHOULD NOT RUN!**

7. Repeat the above steps for the leak detect valve.

8. Attach a new sealing wire to the air Shut-Off Valve handles and record your results.

DEVICE ASSEMBLY - CHERRY BURRELL FDD

1. With the system temperature at sub-legal (divert), set the FDV MODE Switch to INSPECT.

2. After the valves have assumed the FORWARD FLOW position, turn the air shut-off valve handle 90 degrees which traps the air and retains the valve in the forward flow position.

3. Set the FDV MODE Switch to PROCESS and turn on the metering pump. The pump or any other flow promoting devices should not operate.

4. Set the FDV MODE Switch to OFF. Slowly open the actuator air Shut0Off valve until the piston rod moves very slightly (about 1/4 inch), then close the Sutt-Off valve.

5. Using two open-end wrenches, unscrew the valve stem from the piston rod (about 1/8 inch). Slowly open the Shut-Off valve again allowing the valve to assume the Divert position.

6. Set the FDA MODE Switch to PROCESS and turn the metering pump on. The metering pump nor any other flow promoting device should not operate.

7. Repeat the above steps for the leak detect valve.

8. Attach a new sealing wire to the air Shut-Off Valve handles and record your results.

TESTING METHOD: TRI-CLOVER DUAL STEM DEVICE

1. Remove the recorder/controller temperature sensor from the water bath or cool the bath to a temperature that will allow diverted flow.

2. Remove **one actuator clamp** On most dual valves this is the TOP CLAMP.

3. Turn the mode switch on the FDD control panel to **INSPECT**.

4. Once the valve has assumed the forward flow position, disconnect the stem from the actuator.

5. Turn the mode switch back to **PRODUCT** which will allow the valve to assume the divert position. Turn on the metering pump switch. The **metering pump should not run.** Note: At this time you may want to complete disassembly of the valve and inspect for construction, gaskets, "O" rings, etc.

6. Turn the mode switch back to **INSPECT** and allow the valve to assume the forward flow position.

7. Reconnect the stem to the actuator.

8. Turn the mode switch from **INSPECT** to **PRODUCT** and allow the valve to assume the divert flow position.

9. Reconnect the actuator clamp.

Corrective Action--If metering pump fails to respond as indicated, an immediate check of the device assembly, MICROSWITCH, and wiring is required to locate and correct the cause.

TESTING METHOD, TRI-CLOVER :REVERSE-ACTION FDD

1. Make certain the valves are properly assembled, paying particular attention to the actuator mounting bolts, yolk mounting bolts, body clamps, and the valve stem to actuator stem connection.

2. Make sure the temperature sensing element of the STLR is below legal pasteurization temperature.

3. Momentarily turn on the timing pump to make sure it is operating properly , and then turn it off.

4. Remove the valve body clamp and the uper valve body port clamp on the valve. Lift the valve off the lower body. Turn the selector switch to the **"INSPECT"** position. After a time delay, the valve will switch to the forward flow position. Unscrew the valve stem off the actuator stem enough to insert the gap guage between the two stems. Tighten the valve stem onto the guage.

5. Turn the selector switch to the **"PRODUCT"** position and observe the timing pump. It should not operate nor should any flow promoting device be operable during this time.

6. Remove the gap guage and reassemble the valve. Ensure that the valve is properly assembled. The timing pump should now operate normally in the divert position.

7. Repeat procedure for remaining valve.

5.5 MANUAL DIVERSION (when booster pump is installed in the HTST system)

Apparatus.--None.

Method.--Observe the response of the system to manual diversion.

Procedure:

a. With the HTST system in operation and the flow-diversion device in the forward-flow position, press the manual diversion button. This should;

1. Cause the valve to assume the **divert** position, and

2. **de-energize the booster pump**; (the pressure differential between raw and pasteurized milk in the regenerator should be maintained).

b. Operate the HTST system at its **maximum operating pressure** and activate the manual divert button. Confirm that the spring tension of the flow-diversion device is still capable of diverting the system at maximum operating pressure.

c. Operate the HTST system in **forward flow** and activate the manual divert button until the raw pressure reaches zero (0) psi. Deactivate the manual divert button and observe the raw milk and pasteurized milk pressures. **The pressure differential between raw and pasteurized milk in the regenerator should be maintained**.

Corrective Action--If the above described actions do not occur when procedures a, b, and c are performed, or the necessary pressure differential between raw and pasteurized milk is not maintained, the assembly and wiring

of the HTST system must be immediately reviewed and the indicated deficiencies corrected or proper adjustments made.

5.6 RESPONSE TIME

Apparatus--STOPWATCH. The stopwatch should be used to determine that the response time interval does not exceed 1 second.

Method--Determine the elapsed time between the instant of the activation of the control mechanism at **cut-out temperature on declining temperature and the instant the flow-diversion device takes the fully diverted-flow position.**

Procedure:

a. With water bath or oil bath at a temperature above cut-out temperature, allow the water or oil to cool gradually. At the moment the cut-out mechanism is activated, start the watch and the moment the flow-diversion device takes the fully-diverted position, stop the watch.

b. Record results.

c. Re-seal regulatory controls as necessary.

Corrective Action--Should response time exceed 1 second, immediate corrective action must be taken.

5.7 TIME DELAY INTERLOCK WITH METERING PUMP.

Application--To dual stem flow-diversion devices with a manual forward-flow switch.(**INSPECT** position on the mode switch).

Apparatus--None.

Method--Determine that the device does not assume a manually induced forward-flow position while the metering pump or other flow promoting devices capable of causing flow through the holding tube is running.

Procedure--With the system running in **forward flow**, move the control switch to the **"Inspect**" position and observe that the following events automatically occur in sequence:

a. The device **immediately moves to the diverted-flow** position and the metering pump and all other flow promoting devices are turned off or in the case of separators are effectively falved out of the system.

b. The device remains in the diverted-flow position while the metering pump and all other flow promoting devices are running down or in the case of separators, are valved out.

c. After the metering pump and other flow promoting devices have stopped, or valved out, the device assumes the forward-flow position.

d. Repeat the above procedure by moving the control switch to the clean-in-place (CIP)position for those systems in which no milk flow promoters are allowed to operated during CIP.

d. Record test results and seal the control enclosure as necessary.

Corrective Action--If the above sequence of events does not occur, either a timer adjustment or wiring change is required.

5.8 CIP TIME DELAY RELAY

Application--To all continuous flow pasteurizer systems in which it is desired to run the **timing pump and/or other flow promoting devices during CIP** without the controls required during processing.

Criteria.--When the mode switch on the flow diversion device is moved from process product to CIP, the flow diversion device shall move immediately to the diverted position and remain in the diverted position for at least 10 minutes with all controls and safe guards required in product mode in placed and functioning, before starting its normal cycling in the CIP mode. In HTST systems, the booster shall be de-energized during this 10minute time delay.

Note: Also, any flow promoting devices capable of causing improper pressure relationships in the milk-to-milk regenerator must either be deactivated or automatically valved out of the system during this ten minute time delay. An example of this would be pasteurized side flavor control equipment, and/or separators located on the pasteurized side of the system.

Apparatus.--Stopwatch.

Method.--Determine that the set point on the time delay is **equal to, or greater than 10 minutes.**

Procedure.--

a. Operate pasteurizer in forward flow with the mode switch on the flow diversion device in the PROCESS/PRODUCT position, using water above the cut-in temperature. In systems equipped with magnetic flow meter based timing systems, operate the system at a flow rate below the Flow Alarm set point and above the Loss-of-Signal Alarm set point.

b. Move the mode switch on the flow diversion device to the **CIP position**. The flow diversion device should move immediatey to the diverted position. **Start the stopwatch when the flow diversion device moves to the diverted position**. Check all controls and safeguards which are required to be in operation when the system is in PRODUCT mode and in diverted flow. For

example, in HTST systems, the booster pump must stop runing. Separators located between raw regenerator sections or those located on the pasteurized side of the system must be effectively valved out and stuffer pumps for such separators must be de-energized.

c. **Stop the stopwatch when the CIP timer times out**. On most systems this is when the flow diversion device moves to the forward position for its initial cycle in the CIP mode. **At this time the system may be operated without the controls and safe guards normally required during product processing**. For example, the booster may start at this time without requiring proper regenerator pressures.

d. Record results for the office record.

e. Install and seal enclosure over the time delay relay if necessary.

Corrective Action.--If the flow diversion device does not remain in the diverted position for at least 10 minutes after the mode seitch is moved from PRODUCT/PROCESS to CIP, increase the set point on the time delay and repeat the test procedure. All required safe guards and controls must be functional during this entire 10 minutes. If any of these required safeguards or controls are not functional during this 10 minutes, adjustments or repairs are needed. In HTST systems, if the booster pump runs at any time during the 10 minute delay, the booster pump wiring is in need of repair.

METER BASED SYSTEMS - While operating the system on water at or above the minimum pasteurization temperature and with a flow rate below the Flow Alarm set point and above the Loss-of-Signal Alarm set point;

1. Turn the flow diversion device mode switch to the CIP position. The flow diversion device should move immediately to the diverted position, and the booster pump should stop running and separators located between regenerator sections or on the pasteurized side of the system must be effectively valved out and stuffer pumps for such separators must be de-energized..

2. Start the stopwatch when the flow diversion device moves to the diverted position.

3. Stop the stopwatch when the flow diversion device moves to the forward position for its initial cycle in the CIP mode. The booster pump and other flow promoting devices (separators and stuffer pumps) may start at this time.

b. Record results for the office record.

c. Install and seal enclosure over the time delay relay.

Corrective Action.--If the flow diversion device does not remain in the diverted position for at least 10 minutes after the mode switch is moved from process product to CIP, increase the set point on the time delay relay and repeat this test procedure. If the booster pump runs at any time during the 10 minute delay, the booster pump wiring is in need of repair.

5.9 Leak Detect Valve Flush - Time Delay

Application- - The minimum one second delay applies to HTST systems in which space between the divert and leak detect valves are not self draining in the diverted flow position.

IMPORTANT: The five second maximum flush delay does not apply to systems that do not have a restrictor in the divert line or to meter based timing systems.

Criteria -- The **piping joining the divert and leak detect valve will be flushed for at least one second and not more than five seconds after the divert valve moves to the forward flow position and before the detect valve moves to the forward postion.**

Apparatus -- A stopwatch.

Method-- Observe the movement of the divert and detect valves to the forward flow positiojn and measure the time interval between the movement of the two valves.

Procedure --

1. Move the flow diversion device from the diverted flow position to the forward flow position either by raising the temperature above the cut-in set point or by operating the HTST pasteurizer above the cut-in temperature in manual divert mode and releasing the manual divert activating (NO)push button or switch.

2. When the **divert valve begins to move to the forward flow position, start the watch.**

3. When the **leak detect** valve begins to move to the forward flow position, **stop the watch.**

4. Record the elapsed time.

5. If the elapsed time is **at or above one second (all systems), and at or below five seconds, (meter based systems or non-restricted divert lines systems not applicable) seal the time delay.**

Corrective Action-- If the elapsed time is less than one second or greater than five seconds, appropriate changes to the system or system controls must be made.

TEST 6
LEAK PROTECTOR VALVE-BATCH PASTEURIZERS

Reference--Item 16p(E).

Application--To all **batch (vat) pasteurizer outlet valves**.

Frequency--Upon installation and at least once each 3 months thereafter.

Criteria--No leakage of milk past the valve seat in any closed position.

Apparatus--No supplementary materials required.

Method--By observing when the piping is disconnected from the valve outlet whether or not leakage past the valve seat occurs when pressure is exerted against the upstream face of the valve.

Procedure.--

1. During normal operation, while milk pressure is exerted against the valve inlet, fully close the outlet valve and disconnect the outlet piping.(Caution: care must be taken to avoid contamination of the valves or the piping.)

2. Observe whether or not any milk is leaking past the valve seat into the valve outlet.

3. Turn the valve to the just-closed position, and examine the leakage into the valve outlet.

4. Reconnect the outlet piping.

5. Record identity of the valve, and findings, for office record.

Corrective Action--If leakage past the valve seat should occur in any closed position, the valve plug should be reground, gaskets replaced, or other necessary steps be taken to prevent leakage.

TEST 7
INDICATING THERMOMETERS ON PIPELINES-- THERMOMETRIC RESPONSE

Reference--Item 16p(E).

Application--To all **HTST indicating thermometers** located on pipelines and used for determination of milk temperatures during pasteurization.

Frequency--Upon installation and once each 3 months thereafter and whenever the seal on a digital thermometer has been broken..

Criteria--Four seconds under specified conditions.

Apparatus--Stopwatch, water bath, agitator, heat supply, and indicating thermometer from pasteurizer.

Method--By measuring the time required for the reading of the thermometer being tested to increase 7°C (12°F) through a specified temperature range (temperature range must include pasteurization temperature). The temperature used in the water bath will depend upon the scale range of the thermometer to be tested. See chart on following page for recommended water bath temperatures.

Note: This test is temporarily suspended for indicating thermometers used on UP and UHT systems until research demonstrates effective and safe alternative methods. See M-a-81, June 20, 1993, or section AND Chapter entitled "PROCESS DESIGN CRITERIA, CHAPTER VI, STEAM INJECTION AND INFUSION".

Procedure.--

1. Immerse indicating thermometer in water bath heated to a temperature at least 11°C (19°F) higher than minimum scale reading on indicating thermometer**. The bath temperature should be 4°C (7°F) higher than maximum required pasteurization temperature for which thermometer is used.**

2. Immerse indicating thermometer in bucket of cold water for several seconds to cool it.

Note.--Continuous agitation of water baths during the performance of steps 3, 4, and 5 is required. Elapsed time between end of step 1, and beginning of step 3 should not exceed 15 seconds so hot water bath does not cool significantly.

3. Insert indicating thermometer in hot water to proper bulb/sensor immersion depth.

4. **Start** stopwatch when indicating thermometer reads 11°C **(19°F) below bath temperature.**

5. **Stop** stopwatch when indicating thermometer reads 4°C **(7°F) below bath temperature.**

6. Record thermometric response time for office record.

Examples:--On a thermometer with a range of 66°C to 80°C (150°F to 175°F) used at pasteurization temperatures of 72°C and 75°C (161°F and 166°F), a water bath of 78.3°C (173°F) could be used. 10.6°C (19°F) below 78.3°C (173°F) would be 68.7°C (154°F); 3.9°C (7°F) below 78.3°C (173°F) would be 74.4°C (166°F). Hence, after immersing the thermometer which has been previously cooled, place the thermometer in the 78.3°C (173°F) bath, the stopwatch is started when the thermometer reads 67.8°C (154°F) and stopped when it reads 74.3°C (166°F).

NOTE.--The above test included the pasteurization temperature of 71.7°C (161°F) and 74.4° C (166° F). If the pasteurization temperature set points had been 71.7° C (161° F) AND 79.4° C (175° F) it would

have not been possible to include both set points within a 6.7° C (12° F) span. With these set points the test would have to be done separately for each set point.

Therefore, a thermometer used at pasteurization temperature of 175° F could use a water bath of 182° F and the measured time span would be 163° F to 175° F.

THERMOMETRIC RESPONSE TEST

QUICK REFERENCE

PASTEURIZATION TEMPERATURE	WATER BATH TEMPERATURE	TIMED 12°F SPAN	
		Start Timer	Stop Timer
161°F, 166°F	173°F	154°F	166°F
175°F	182°F	163°F	175°F

Corrective Action--If the response time should exceed 4 seconds, the thermometer should be replaced or returned for repair.

TEST 8
RECORDER/CONTROLLER-THERMOMETRIC RESPONSE

Reference--Item 16p(E).

Application--To **all HTST recorder/controllers** used in connection with continuous-flow pasteurizers **except** those in which the flow-diversion device is located at the end of the cooler section, ie, HHST and Aseptic Processing Systems.

Frequency--Upon installation and at least once each **3 months** thereafter.

Criteria--Five seconds, under specified conditions.

Apparatus--Previously tested indicating thermometer (on pasteurizers), stopwatch, water bath, agitator, and heat supply.

Method--Measure the time interval between the instant when the recording thermometer reads 7°C (12°F) below the cut-in temperature and the moment of cut-in by the controller. This measurement is made when the sensing element is immersed in rapidly agitated water bath maintained at **exactly** 4°C (7°F) above the cut-in temperature.

Procedure.--

1. Check and, if necessary, adjust the pen-arm setting of the recording thermometer in the proper reference to agree with the indicating thermometer reading at pasteurization temperature.

2. Determine the cut-in temperature of controller (Test 10, p. 224), either while in normal operation or by using a water bath.

3. Remove sensing element and allow to cool to room temperature.

4. Heat water bath to exactly 4°C (7°F) above the cut-in temperature while **vigorously agitating bath** to insure uniform temperature.

5. Immerse recorder/controller bulb in bath. **Continue agitation during steps 6 and 7 below.**

6. Start stopwatch when the recording thermometer reaches a temperature of **7°C (12°F) below the cut-in temperature.**

7. **Stop stopwatch when the controller cuts in.**

8. Record thermometric response time for office record. Re-seal any regulatory seals broken during the test.

Corrective Action: If the response time should exceed 5 seconds the recorder controller must be repaired.

TEST 9
REGENERATOR PRESSURE CONTROLS

Reference--Item 16p(E).

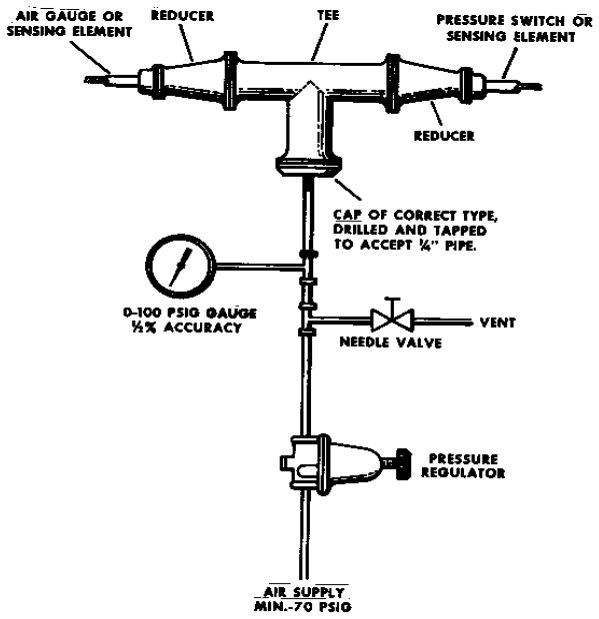
9.1 PRESSURE SWITCHES.--Used to control operation of booster pumps.

Application--To all pressure switches controlling the operations of booster pumps **on HTST pasteurizer systems employing regenerators**.

Frequency--Upon installation, **each 3 months** thereafter, after any change in the booster pump or the switch circuit, and/or whenever the pressure switch seal is broken.

Criteria--The pump shall not operate unless there is at least a 6.9kPa (1psi) pressure differential on the pasteurized milk side of the regenerator.

Apparatus--Sanitary pressure gauge and pneumatic testing device, for checking and adjusting pressure switch settings. (See illustration)



PNEUMATIC TESTING DEVICE

1. A simple inexpensive pneumatic testing device may be made from a discarded 50 millimeter (2 inch) - 7BX sanitary tee, with two additional 13H nuts, one of which is provided with a 16A cap, drilled and tapped for a 13 millimeters (½-inch) galvanized iron nipple for the air connection.

2. A hose connection is made to a compressed air source in the plant by means of a snap-on fitting. The air pressure can be controlled by an inexpensive pressure reducing valve (range [0-60] psig) followed by a 13 millimeters (½ inch) globe type bleeder valve connected into the side outlet of a 13 millimeters (½-inch) tee installed between the pressure reducing valve and the testing device.
3. The pressure switch to be tested is disconnected from the pasteurizer and connected to another of the outlets of the sanitary tee, and the pressure gauge is connected to the third outlet of the sanitary tee.

4. By careful manipulation of the air pressure reducing valve and the air bleeder valve, the air pressure in the testing device may be regulated slowly and precisely. (In operating the device, care should be taken to avoid exposing the pressure switch and the sanitary pressure gauge to excessive pressure which might damage them). This can be done by first closing off the air pressure regulating valve and opening fully the bleeder valve; these may then be manipulated slowly to bring the air pressure in the testing device within the desired range.) A test light of proper voltage can be placed in series with the pressure switch contact and in parallel with the electrical load (booster pump starter) so the actuation point may be readily determined.

Method--Check and make adjustment of pressure switch so as to prevent the operation of the booster pump unless the pressure of the pasteurized milk side of the regenerator is greater by at least 6.9 kPa (1 psi) than any pressure that may be generated on the raw side.

Procedure:- Early type

a. Determine maximum pressure of booster pump.

(1) Install sanitary pressure gauge in tee at discharge of booster pump.

(2) Operate the pasteurizer with water with the flow-diversion device in forward-flow position, the metering pump operating at minimum speed possible, and the booster pump operating at its rated speed. If vacuum equipment

is located between the raw outlet from the regenerator and the metering pump, it should be bypassed while this determination is made.

(3) Note maximum pressure indicated by pressure gauge under these conditions.

b. Check and set the pressure switch.

(1) Install a sanitary pressure gauge of known accuracy on the pneumatic testing device to which the pressure switch sensing element should also be connected.

(2) Remove the seal and cover to expose adjustment mechanism on pressure switch.

(3) Operate the testing device and determine the pressure gauge reading at the **cut-in point of the pressure switch which will light the test lamp**. (If the switch is short circuited, the lamp will be lighted before air pressure is applied.)

(4) The cut-in point should be adjusted, if necessary, so as to occur at a pressure gauge reading at least 6.9 kPa (1 psi) greater than the maximum booster pump operating pressure, as determined under section a. of this method. Where adjustment is necessary, refer to manufacturer's instructions for adjusting procedure. After adjustment, recheck actuation point and readjust if necessary.

(5) Replace cover and seal the pressure switch and restore sensing element to original location.

(6) Record test results for the office record.

9.2 DIFFERENTIAL PRESSURE CONTROLLER

Application--Part 2.1 applies to all differential pressure controllers used to control the operation of booster pumps on **HTST and HHST** systems, or used to control operation of flow-diversion devices on HHST and aseptic processing systems when no vacuum breaker is located downstream from the holding tube.

Part 2.2 applies only to HTST systems

Part 2.3 applies to the testing of HHST systems in which the differential pressure controller is used to control the operation of the flow diversion dievice. Test 2.3 also applies to aseptic processing systems in which the differential pressure controller is used to control the flow diversion device, product divert system, product divert valve or other acceptable control system.

Frequency--Upon installation, **each 3 months** thereafter, and whenever the differential pressure controller is adjusted or repaired or whenever the regulatory seal is broken.

Criteria--The booster pump shall not operate or the pasteurizer shall not operate in forward flow unless the product pressure in the pasteurized side of the regenerator is at least 6.9 kPa (1 psi) greater than the product pressure in the raw side of the regenerator. When the differential pressure controller is used to control the flow-diversion device on HHST systems, and improper pressure occur in the regenerator, the flow diversion device shall move to the diverted-flow position and remain in diverted flow until proper pressures are re-established in the regenerator and all product contact surfaces between the holding tube and flow-diversion device have been held at or above the required pasteurization temperature, continuously and simultaneously for at least the required pasteurization time as defined in Definition S of this *Ordinance*.

Apparatus--A sanitary pressure gauge and a pneumatic testing device described under PRESSURE SWITCHES (Test 9,1) above can be used for checking and adjusting the differential pressure switch setting.

Method--The differential pressure switch is checked and adjusted to prevent operation of the booster pump, or prevent forward flow, unless the product pressure in the pasteurized or aseptic side of the regenerator is at least 6.9 kPa (1 psi) greater than the pressure in the raw side of the regenerator.

9.2.1 CALIBRATION OF DIFFERENTIAL PRESSURE CONTROLLER PROBES

Procedures--

a. Loosen the process connection at both pressure sensors and wait for any liquid to drain through the loose connections. (**Note: At this point do not remove sensors from their location on the press).** Both pointers should be within 3.5 kPa (0.5 psi) of .0 kPa (0 psig). **If not, adjust pointer(s) to read 0 kPa (0 pounds psig).**

b. **After identifying both sensors (raw and pasteurized)** remove them from the processor and mount them in a tee, either at the discharge of the booster pump, or connected to the pneumatic testing device. Note (in writing, if necessary) the separation between the two pointers. (The change in elevations of the sensors may have caused some change in the zero readings).

Turn on the booster pump switch and depress the test push button to operate the booster pump.

> **Note:** *If the pneumatic testing device is used in lieu of the booster pump, adjust air pressure to the normal operating pressure of the booster pump.*

Note that the pointer, or digital display reading separation is within 6.9 kPa (1psi) of that observed before pressure was applied. If not the instrument requires adjustment or repair.

c. Record the test results for the office record. Reseal the instrument controller and any seals broken on electronic pressure sensor devices.

FOR PNEUMATIC OPERATED PRESSURE DIFFERENTIAL CONTROLLERS

1. Quickly exhaust the air from the pneumatic tube while closely observing the pressure indicators as they drop to their static position or "0". If the comparison exceeds ± scale unit during the drop , the unit in need of further evaluation. Probable causes may be:

a) Unequal sized capillaries (raw v.s. pasteurized)
b) Unequal lengths of capillaries.
c) Damaged capillary(s), (crimped, etc)

Note: Both raw and pasteurized capillary tubes should be replaced at the same time. Also both should be the same length and internal diameter.

2. Note that both of the pointers separation is within .07 kPa (1 psi) of that observed before pressure was applied. If not, the instrument, sensors or capillary are malfunctioning and require immediate maintenance.

c. Device specific testing procedures

TESTING THE DIFFERENTIAL CONTROLLER WITH A CDT DEVICE

A. DEVICE ACCURACY TEST

1. Attach the tubing from **OUTLET A** to the **PASTEURIZED SENSOR.**
2. Attach the tubing from **OUTLET B** to the **RAW SENSOR.**
3. Attach an supply air hose to the CDT.
4. Place the selector switch in the **AA position.**
5. Turn regulator **A** until the pressure gauge on the CDT reads 40 psi.
   both sensors should also read 40 psi (within ½ of scale division)
6. Turn regulator **A** to the left until all of the air is released.
   both sensors should read 0 psi (within ½ of scale division)

B. HTST DIFFERENTIAL PRESSURE CONTROLLER TEST (Taylor Model's #117 and 447K)

1. Place the selector in the **AB** position.
2. Turn regulator **A and regulator B** to the right until the plants differential pressure controller (DPC) reads 40 psi for both pointers.
3. Depress the test (or over-ride) button on the DPC and simultaneously adjust regulator **A** to the right (increasing the air pressure on the pasteurized sensor) until the pasteurized pressure has increased a minimum of one scale division. The DPC indicator light should go on.
4. Gradually (no faster than 1 psi per 5 seconds) decrease the pasteurized sensor air pressure by turning regulator **A** to the left. At the point when the indicator light goes off, note the pressure differential on the plants DPC. This is recorded as the official tested PRESSURE DIFFERENTIAL.

5. Quickly release all air pressure from both sensors until both sensors on the DPC read 0 psi.
6. Repeat test #3. The pressure differential should be identical at 0 psi and 40 psi.
Note: A suitable test light or voltage meter across two leads from the magnetic starter may be used to test booster pump on and off operation.

9.2.2 HTST--INTERWIRING OF THE PRESSURE DIFFERENTIAL CONTROLLER WITH THE BOOSTER PUMP

Method--Determine if the booster pump stops when the pressure differential is not properly maintained in the regenerator.

Procedure.--

a. Connect the **pasteurized pressure sensor** to a testing tee with the other end of the tee capped. Caution-- If there is water in the HTST system, ensure that the recorder/controller probe and the pasteurized sensor ports are capped before the metering pump is turned on.

b. Turn on the metering pump and the booster pump.

c. Place the **recorder/controller probe in hot water** which is above the cut-in temperature.

d. **Apply and adjust air supply** to the tee to provide an **adequate pressure differential to start the booster pump.**

e. Decrease the air supply to the testing tee until the pressure is less than **14 kPa (2psi)** of the pressure on the **raw milk** pressure sensor. **The booster pump should have stopped. Ensure that the flow diversion device remains in the forward flow position and the metering pump continues to operate.**

f. Reseal regulatory controls as necessary and record test results fot the office record.

Corrective Action--If the booster pump fails to stop when the pressure differential is not maintained, have the plant maintenance personnel or manufacturers service representative, etc, determine and correct the cause.

9.2.3 HHST AND ASEPTIC PROCESSING -- INTERWIRING OF THE PRESSURE DIFFERENTIAL CONTROLLER WITH THE FLOW DIVERSION DEVICE IN AN HHST SYSTEM OR AN ACCEPTABLE ALTERNATIVE DEVICE OR SYSTEM IN ASEPTIC PROCESSING EQUIPMENT.

Application--

a. To all differentail pressure controllers used to control the operation of flow diversion devices on HHST systems when no vacuum breaker is located downstream from the holding tube, and

b. To all differential pressure controllers used to control the operation of flow diversion devices, product divert systems, product divert valve(s) or other acceptable control systems used in aseptic processing equipment.

Apparatus.--A sanitary pressure guage and a pneumatic testing device, described under PRESSURE SWITCHES, (Test 9.1) above can be used for checking and adjusting the differential pressure switch setting.

Method.--The differential pressure switch is checked and adjusted to prevent forward flow, unless the product pressure in the pasteurized side of the regenerator is at least 6.9 kPa (1 psi) greaater than the pressure in the raw product side of the regenerator. In the case of product to water to product regenerators protected on the pasteurize or aseptic side, the water side of the regenerator shall be considered to be the “raw product” for purposes of this test.

Procedures.--

a. Wire a test lamp in series with the signal from the pressure differentail switch to the flow diversion device.

b. Calibrate the pressure switch and probes (using test 9.2.1)

c. 1. Adjust the pressure on the pressure switch sensors to their normal operating pressures (with the pasteurized, or aseptic pressure at least 14 kPa (2 psi) higher than the raw product pressure.

2. The test lamp should be lit. If the test light is not lit, increase the pasteurized, or aseptic pressure (or lower the raw product pressure) until the test light is lit.

3. Gradually lower the pasteurized, or aseptic side (or raise the raw product pressure) until the test light turns off.

4. The test light should turn off when the pasteurized, or aseptic pressure is 14 kPa (2 psi) or more haigher that the raw product pressure.

5. Note the differential pressure at the point the light turns off.

6. Gradually raise the pasteurized, or aseptic pressure (or lower the raw product pressure) until the test light turns on.

7. The test light should not turn on until the pasteurized, or aseptic pressure is grater than 14 kPa (2 psi) higher than the raw product pressure. Note the differential pressure at the point the light turns off.

Note: This test may be completed using a pneumatic testing device capable of producting differential pressures on the probes. This device should be capable of being operated in a manner so as to duplicate the conditions described above.

d. Seal the instrument and record the test results for the office record.

9.3 ADDITIONAL HTST TESTS FOR BOOSTER PUMPS

Application.--To all booster pumps used for HTST systems.

Criteria.--The booster pump shall be wired so it cannot operate if the flow diversion device is in the diverted position or if the metering pump is not in operation.

Apparatus--A sanitary pressure gauge and pneumatic testing device as described in Test 9. 1, and water with heat source.

9.3.1 BOOSTER PUMPS-- INTERWIRED WITH FLOW-DIVERSION DEVICE

Method--Determine if the booster pump stops by dropping the temperature and causing flow-diversion device to divert.

Procedures:

a. Connect pasteurization pressure sensor to testing tee with the other end of the tee capped. (Caution: if there is water in the HTST system, ensure that the recorder controller probe and pasteurized pressure sensor ports are capped before the metering pump is turned on).

b. Turn on the metering pump and the booster pump.

c. Place the recorder controller probe in hot water which is above the cut-in temperature.

d. Turn on the air supply to provide adequate pressure differential to start the booster pump.

e. Remove the recorder controller probe from the hot water.

f. When the flow-diversion device moves to the diverted flow position, **the booster pump must stop**. Ensure that the pressure differential remains adequate and the metering pump continues to operate.

g. Reseal regulatory controls as necessary and record test results for office records.

Corrective Action--If the booster pump fails to stop when the flow-diversion device is in the diverted flow position, have the plant maintenance personnel check the wiring and correct the cause.

9.3.2 BOOSTER PUMPS-- INTERWIRED WITH METERING PUMP

Method--Determine if booster pump stops when metering pump is off.

Procedure.--

a. Connect pasteurization pressure sensor to testing tee with the other end of the tee capped. (Caution: if there is water in the HTST system, ensure that the recorder controller probe and pasteurized pressure sensor ports are capped before the metering pump is turned on).

.

b. Turn on the metering pump and the booster pump.

c. Place the recorder/controller probe in hot water which is above the cut-in temperature.

d. Provide an adequate pressure differential to allow the booster pump to start.

e. Turn off the metering pump. The booster pump must stop. Ensure that the pressure differential remains adequate and the flow diversion device remains in the forward flow position.

f. Record the test results for the office record.

Corrective Action.-- If the booster pump fails to stop when the metering pump is turned off, have the plant maintenance personnel determine and correct the cause.

Test 10
MILK FLOW CONTROLS- MILK TEMPERATURES AT CUT-IN AND CUT-OUT

References-- Item 16p(B), 16p(E).
Milk flow controls shall be tested for milk temperature at cut-in and cut-out by one of the following applicable tests at the frequency prescribed.

10.1 HTST PASTEURIZERS

Application--All recorder/controllers used in connection with HTST pasteurizers.

Frequency--Upon installation and at least once each three months by the regulatory agency; daily by the plant operator, or when a regulatory seal has been broken.

Criteria--No forward flow until pasteurization temperature has been reached. Flow diverted before temperature drops below minimum pasteurization temperature.

Apparatus--No supplemental materials needed.

Method--By observing the actual temperature of the indicating thermometer at the instant forward flow starts (cut-in) and stops (cut-out).

Procedure:

a. **CUT-IN TEMPERATURE**

(1) While milk or water is completely flooding the sensing element of the recorder/controller and the indicating thermometer, increase the heat gradually so as to raise the temperature of the water or milk at a rate not exceeding 0.5°C (1°F) every 30 seconds. If a water bath is used in place of water or milk flowing through the system, the water bath shall be adequately agitated during this test.

(2) Observe the **indicating thermometer** reading at the moment the **forward flow starts (i.e., flow-diversion device moves)**. Note: Observe that the frequency pen reading is synchronized with the recording pen on the same reference arc.

(3) Record the indicating thermometer reading on the recorder chart; inscribe initials. The regulatory agency shall record test findings.

b. **CUT-OUT TEMPERATURE.**

(1) After the cut-in temperature has been determined and while the milk or water is above the cut-in temperature, allow the water to cool slowly at a rate not exceeding (0.5°C) 1°F per 30 seconds. Observe **indicating thermometer** reading at the instant forward flow stops.

(2) Reseal the regulatory controls as necessary and record the indicating thermometer reading on the recorder chart and initial.

Corrective Action.--Should the reading be below the minimum pasteurization temperature, the cut-in and cut-out mechanism and/or the differential temperature mechanism should be adjusted to obtain proper cut-in and cut-out

temperatures by repeated tests. When compliance is achieved, seal the controller mechanism.

10.2 HHST PASTEURIZERS AND ASEPTIC PROCESING SYSTEMS USING INDIRECT HEATING

Application.--All HHST pasteurizers and aseptic processing systems using indirect heating. When testing aseptic processing systems, the "product divert system" or product divert valve or acceptable control system may be substituted for the flow diversion device when it is referenced in this test.

Frequency--Upon installation, and every 3 months thereafter; whenever the thermal controller seal is broken.

Criteria--The pasteurizer or aseptic processor shall not operate in forward flow unless pasteurization or aseptic processing temperature has been achieved. The product flow shall be diverted at a temperature no lower than the chosen pasteurization or aseptic processing standard.

Apparatus--No supplemental materials needed.

Method--The cut-in and cut-out temperatures are determined by observing the actual temperature in the constant temperature bath at which the two sensing elements signal for forward flow (cut-in) and diverted flow (cut-out).

Procedures:

a. Wire the test lamp in series with the control contacts of the sensing element (holding tube). Immerse this sensing element in the constant temperature bath. Raise the bath temperature at a rate not exceeding 0.5°C (1°F) every 30 seconds. Observe the temperature reading at the cut-in temperature. Record the temperature for the office record.

b. After the cut-in temperature has been determined and while the bath is above the cut-in temperature, allow the bath to cool slowly at a rate not exceeding

0.5°C (1°F) per 30 seconds. Observe the temperature reading on the controller when the test lamp goes out (cut-out temperature). Determine that the cut-out temperature on the thermal limit controller is equivalent to or greater than the chosen pasteurization or aseptic processing standard

Corrective action-Where adjustment is necessary, refer to manufacturer's instructions. After adjustment, repeat the procedure above and when the results are satisfactory, record results for the office records.

c. Repeat the procedure for the other sensing element, (flow-diversion device). When proper cut-out temperature has been verified for both sensing elements, seal the controller system.

10.3 HHST PASTEURIZERS AND ASEPTIC PROCESSING SYSTEMS USING DIRECT HEATING

Application--All HHST pasteurizers and aseptic processing systems using direct contact heating. When testing aseptic processing systems, the "product divert system" or product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in this test.

Frequency--Upon installation, and every 3 months thereafter, whenever the thermal limit controller seal is broken.

Criteria--The pasteurizer or aseptic processorshall not operate in forward flow unless pasteurization or aseptic processing temperature has been achieved. The product flow shall be diverted at a temperature no lower than the chosen pasteurization or aseptic standard.

Apparatus--No supplemental materials needed.

Method--The cut-in and cut-out temperatures are determined by observing the actual temperature in the constant temperature bath at which each of the three sensing elements signals for forward flow (cut-in) and diverted flow (cut-out).

Procedures:

a. Wire the test lamp in series with the control contacts of the sensing element (the holding tube). Immerse this sensing element in the constant temperature bath. Raise the bath temperature at a rate not exceeding 0.5°C (1°F) every 30 seconds. Observe the temperature reading on the controller when the test lamp lights (cut-in temperature). Record the temperature for the office record.

b. After the cut-in temperature has been determined and while the bath is above the cut-in temperature, allow the bath to cool slowly at a rate not exceeding 0.5°C (1°F) per 30 seconds. Observe the temperature reading on the controller when the test lamp goes out (cut-out temperature). Determine that the cut-out temperature on the thermal limit controller is equivalent to or greater than the chosen pasteurization or aseptic processing standard. Where adjustment is necessary, refer to manufacturer's instructions. After adjustment, repeat the procedure above and when the results are satisfactory, record the results for the office record.

c. Repeat the procedure for the other two sensing elements, i.e., the vacuum chamber and flow-diversion device. Rewire the test lamp in series with the control contacts from each sensing element, respectively. When proper cut-out temperatures have been verified for all three sensing elements, seal the controller system.

TEST 11
CONTINUOUS FLOW HOLDERS-HOLDING TIME

Reference--Item 16p(B).
Continuous flow holders shall be tested for holding times by one of the applicable tests.

11.1-- HTST PASTEURIZERS--(except for magnetic flow meter systems)

Application--To all HTST pasteurizers.

Frequency--Upon installation and semiannually thereafter, whenever seal on speed setting is broken; any alteration is made affecting the holding time, the velocity of the flow (such as, replacement of pump, motor, belt, drive or driven pulleys, or decrease in number of HTST plates or the capacity of holding tube); or whenever a check of the capacity indicates a speedup.

Criteria--Every particle of milk shall be held for at least 15 seconds in both the **forward and diverted flow positions**.

Apparatus--Electrical conductivity measuring device, Appendix I, capable of detecting change in conductivity, equipped with standard electrodes; table salt (sodium chloride), suitable method of injecting saline solution, stopwatch; suitable container for salt solution.

Method--The holding time is determined by timing the interval for an added trace substance to pass through the holder. Although the time interval of the fastest particle of milk is desired, the conductivity test is made with water. The results found with water are converted to the milk flow time by formulation since a pump may not deliver the same amount of milk as it does water.(1)

Procedure.--

a. Examine the entire system to insure that all flow promoting equipment is operating at maximum capacity and all flow impeding equipment is so adjusted or bypassed as to provide the minimum of resistance to the flow. There shall be no leakage on the suction side of the timing pump.

b. Adjust variable speed pump, including electronic pump control boxes, to its maximum capacity (preferably with a new belt and full size impellers). Check homogenizers for seals and/or gears or pulley identification.

c. Install one electrode at the inlet to the holder and the other electrode in the holder outlet. Close the circuit to the electrode located at the inlet to the holder.

d. **Operate the pasteurizer using water at pasteurization temperature**, with flow-diversion device in forward-flow position.

e. Quickly inject 50 ml. of saturated sodium chloride solution or other suitable conductant (such as an adequate strength acid solution) into the holder inlet.

f. Begin the timing process (automatically or with stopwatch) with the first movement of the indicator of a change in conductivity or by other automatic means. Open the circuit to the inlet electrode and close the circuit to the electrode at the outlet of the holder.

g. End the timing process (automatically or with a stopwatch) with the first movement of the indicator of a change in conductivity.

h. Record results.

I. Repeat the test six or more times, until six successive results are within 0.5 seconds of each other. The average of these six tests is the holding time for water in **forward flow**. When consistent readings cannot be obtained, purge the equipment, check instruments and connections, and check for air leakage on suction side. Repeat tests. Should consistent readings not be obtained, use the fastest time as the holding time for water.

j. Repeat steps d. through I. for testing time on water in **diverted flow**.

k. With the pump at the same speed and equipment adjusted as in a. above, **time the filling of a 38 liter (10-gallon) can with a measured weight of water using the discharge outlet with the same head pressure as in normal operation.** Average the time of several trials. (Since flow rates of large capacity units make it very difficult to check by filling a 38 liter (10-gallon) can, it is suggested that a calibrated tank of considerable size or other acceptable methods be used.)

l. For all gear type timing pumps, and homogenizer timing pumps with measured time of less than 120% of the legal holding time, repeat procedure 'k.' using milk.

m. Compute the holding time for milk from the following formula by weight, using the average specific gravity. Compute separately for forward flow and diverted flow.[(1)]

Tm=**(1.032xTw)(Wm/Ww)**, in which--
1.032=specific gravity for milk;
TW=average holding time for water;
Tm= Adjusted holding time for milk
Wm=average time required to deliver a measured weight of milk.
Ww=average time required to deliver an equal weight of water.

n. Record results for office record.

The holding time for milk may also be computed from the following formula by volume. Compute separately for forward flow and diverted flow.

Tm= T(Mv/Ww),in which:

Tm=Adjusted holding time for milk
T=average holding time for water;
Mv=average time required to deliver a measured volume of milk;
Ww=average time required to deliver an equal volume of water.

(1) The computation portion of this test is not required for meter based systems; nor for those **homogenizer based timing systems** with a measured holding time of more than 120% of the legal holding time(s).(for

example, (15 sec=18sec, 25 sec= 30sec). **All gear driven (conventional positive displacement type impeller timing pumps) based timing systems must have computed holding times as described above.**

Corrective Action--When the computed holding time for milk is less than that required either in forward flow or diverted flow, the speed of the timing pump shall be reduced or adjustment made in the holding tube, and the timing test repeated until satisfactory holding time is achieved. Should an orifice be used to correct the holding time in diverted flow, there should be no excessive pressure exerted on the underside of the valve seat of the flow-diversion device. Governors shall be sealed on motors that do not provide a constant speed as provided in Item 16p(B)5b.

11.2A MAGNETIC FLOW METER SYSTEMS; HOLDING TIME

Application.--To all HTST pasteurizers with a Magnetic Flow Meter System used in lieu of a metering pump.

Frequency--Upon installation and semiannually thereafter, whenever seal on the Flow Alarm is broken; any alteration is made affecting the holding time, the velocity of the flow or the capacity of holding tube; or whenever a check of the capacity indicates a speedup.

Criteria--Every particle of milk shall be held for at least a minimum holding time in the **forward flow position**.

Apparatus--Electrical conductivity measuring device, capable of detecting change in conductivity, equipped with standard electrodes; table salt (sodium chloride or other suitable conductive substance), and a suitable method of injecting the conductive solution; a stopwatch or automatic means of determining holding times and suitable container for conductive solutions.

Method--The holding time is determined by timing the interval for an added trace substance to pass through the holder.

Procedure.--

a. Examine the entire system to insure that all flow promoting equipment is operating at maximum capacity and all flow impeding equipment is so adjusted or bypassed as to provide the minimum resistance to the flow.

b. Adjust the set point on the Flow Alarm to its highest possible setting.

c. Adjust the set point on the Flow Controller to a flow rate estimated to yield an acceptable holding time.

d. Install one electrode at the inlet to the holder and the other electrode to the holder outlet. Close the circuit to the electrode located at the inlet to the holder.

e. Operate the pasteurizer using water above pasteurization temperature, with the flow diversion device in **the forward flow position**.
f. Quickly inject 50-ml of saturated sodium chloride solution into the holder inlet.

g. Begin the timing process either automatically or with a stopwatch when the solution first contacts the inlet probes as indicated by a movement of the indicator(change in conductivity) or by other automatic means.

h. End the timing the stopwatch with the first movement of the indicator of a change in conductivity or by automatic means.

I. Record results.

j. Repeat the test six or more times, until six successive results are within 0.5 seconds of each other. The average of these six tests is the holding time for water in **forward flow**. When consistent readings cannot be obtained, purge the equipment, check instruments and connections, and check for air leakage on suction side of the pump located at the raw product supply tank. **If six consecutive readings within 0.5 seconds cannot be achieved in forward flow, the pasteurizing system is in need of repair.**

Note: The requirement for Magnetic Timing System holding time testing in the diverted flow position is no longer required (NCIMS 1997). The reasoning is that in the event of a diversion because of excessive flow rate, the system requires a time delay (15 seconds for milk, 25 seconds for eggnog or frozen dessert mix) after acceptable flow is attained, before the diversion valve can assume the forward flow position. If, during a temperature only divert flow condition, and the maximum allowable flow is exceeded, a 15 second, time delay will be activated automatically before the valves assume the forward flow position.

k. With the Flow Controller at the same set point and equipment adjusted as in © above, time the filling of a 38 liter (10 gallon) can (or a calibrated tank) with a measured volume of water using the discharge outlet with the same head pressure as in normal operation. Average the time of several trials. Other acceptable methods may be used..**Note: The COMPUTED HOLDING TIME (timing of a known**

weight or volume of water and milk and computing the adjusted holding time) is not required for Magnetic Flow Meter Timing based systems.

m. Record this result for office record and reseal the controls as necessary.

Corrective Action.--When the computed holding time for milk is less than that required in forward flow, the set point on the Flow Controller shall be decreased, or adjustment made in the holding tube, and the timing test repeated until satisfactory holding time is achieved.

11.2B CONTINUOUS FLOW HOLDERS--FLOW ALARM

Application--To all continuous flow pasteurization and aseptic processing systems using a Magnetic Flow Meter System to replace a metering pump. When testing aseptic processing systems, the "product divert system" or product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in this test.

Frequency--Upon installation and semiannually thereafter, whenever the seal on the Flow Alarm is broken; any alteration is made affecting the holding time, the velocity of the flow or the capacity of holding tube; or whenever a check of the capacity indicates a speedup.

Criteria--When flow rate equals or exceeds the value at which the holding time was measured, the Flow Alarm shall cause the flow diversion device to assume the diverted position, even though temperature of the milk in the holding tube is above pasteurization or aseptic processing temperature.

Apparatus.--None.

Method--Adjust the set point of the Flow Alarm so that flow is diverted when the flow rate equals or exceeds the value at which holding time was measured.

Procedure.--

a. Operate the pasteurizer or aseptic processing equipment in forward flow, at the flow rate at which holding time was measured, using water above pasteurization or aseptic processing temperature.

b. Adjust set point on the Flow Alarm slowly downward until the frequency pen on the Recorder indicates that flow has been diverted. Note: When performing this test on systems which operate above the boiling point of water, assure that the balance tank resolution return system is cooling and engaged to avoid the possibility of serious burns.

c. Observe that the flow diversion device moves to the diverted position while water passing through the holding tube remains above pasteurization or aseptic processing temperature.

d. Reseal the regulatory controls as necessary and record the set point of the Flow Alarm, the occurrence of flow diversion, and the temperature of the water in the holding tube, for the office record.

Corrective Action.--If the flow diversion device does not move to the diverted position when the frequency pen of the Recorder indicates a diversion, a modification or repair of the control wiring is required.

11.2C CONTINUOUS FLOW HOLDERS; LOW FLOW/LOSS-OF-SIGNAL ALARM

Application--To all continuous flow pasteurization and aseptic processing systems using a Magnetic Flow Meter System to replace a metering pump. When testing aseptic processing systems, the "product divert system" or" product divert valve" or "acceptable control system" may be substituted for the "flow diversion device" when it is referenced in this test.

Frequency--Upon installation and semiannually thereafter, whenever seal on the Flow Alarm is broken; any alteration is made affecting the holding time; the velocity of the flow or the capacity of holding tube; or whenever a check of the capacity indicates a speedup.
Criteria--Forward flow occurs only when flow rates are above the Loss-of-Signal Alarm set point.

Apparatus--None.

Method--By observing the actions of the frequency pens on the recorder and the position of the flow diversion devise.

Procedure.--
a. Operate pasteurizer or aseptic processing system in forward flow, at a flow rate below the Flow Alarm set point and above the Loss-of-Signal Alarm set point, using water.

b. Disrupt power to the magnetic flow meter or decrease the flow through the flow meter below the low flow alarm set point. Observe that the flow diversion devise and both the safety thermal limit recorder frequency pen and the flow rate frequency pen assume the diverted flow position.

c. Reseal regulatory controls as necessary and record results for the office record.

Corrective Action--If the valve does not divert or the pens do not move. Adjustment of the Low Flow Alarm or modification or repair of control wiring is required.

11.2D CONTINUOUS FLOW HOLDERS; FLOW CUT-IN AND CUT-OUT

Application--To all high-temperature short-time pasteurizers using a Magnetic Flow Meter System to replace a metering pump.

Frequency--Upon installation and semiannually thereafter, whenever seal on the Flow Alarm is broken; any alteration is made affecting the holding time, the velocity of the flow or the capacity of holding tube; or whenever a check of the capacity indicates a speedup.

Criteria--Forward flow occurs only when flow rates are below the Flow Alarm set point and above the Loss-of-Signal Alarm set point.
Apparatus--None.

Method--By observing the Recorder readings along with the action of the frequency pen on the Recorder.

Procedure.--

a. Operate pasteurizer in forward flow, at a flow rate **below** the Flow Alarm set point and **above** the Loss-of-Signal Alarm set point, using **water above pasteurizer cut-in temperature**.

b. With the pasteurizer **operating on water above the pasteurizer cut-in temperature and the flow diversion valves in the forward flow position**, use the Flow Controller to **slowly increase the flow rate** until the frequency pen on the **Recorder indicates a flow diversion (flow cut-out point**). The **flow diversion device will also assume the diverted position.** Observe the reading of flow rate from the Recorder the **instant flow cut-out occurs**, as indicated by the frequency pen.

c. With the flow diversion device diverted because of excessive flow rate, and assuring the water remains above the pasteurizer cut-in temperature, slowly **decrease flow rate until the frequency pen on the Flow Recorder indicates the start of a forward flow movement (flow cut-in point)**. Because of the time delay relay described in Test E, the flow diversion device will not move immediately to the forward flow position. Observe the reading from the Flow Recorder, the instant flow cut-in occurs, as indicated by the frequency pen.

d. Reseal regulatory controls as necessary and record results for the office record.

Corrective Action--If the cut-in or cut-out point occurs at a flow rate equal to or greater than the value at which holding time was measured, adjust the Flow Alarm to a lower set point, and repeat the test.

11.2E. CONTINUOUS FLOW HOLDERS- TIME DELAY RELAY

Application--To all high-temperature short-time pasteurizers using a Magnetic Flow Meter System to replace a metering pump.

Frequency--Upon installation and semiannually thereafter, whenever seal on the Flow Alarm is broken; any alteration is made affecting the holding time, the velocity of the flow or the capacity of the holding tube; or whenever a check of the capacity indicates a speedup.

Criteria--Following a flow cut-in, as described in the test for flow cut-in and cut-out, forward flow shall not occur until all product in the holding tube has been held at or above pasteurization temperature for at least the minimum holding time.

Apparatus--Stopwatch.

Method--Set time delay equal to or greater than the minimum holding time.

Procedure:

a. Operate pasteurizer in forward flow, at a flow rate below the Flow Alarm set point and above the Loss-of Signal Alarm set point, using water above pasteurization temperature.

b. Using the Flow Controller**, increase flow rate slowly until the frequency pen on the Flow Recorder indicates a diversion movement, and the flow diversion device moves to the diverted position.** There shall be no time delay between the movements of the frequency pen and the flow diversion device.

c. **With the pasteurizer operating on water above the pasteurizer cut-in temperature, with the flow diversion device diverted because of excessive flow rate, slowly decrease flow rate.**

d. **Start** the stopwatch the instant the **frequency pen on the Flow Recorder** indicates the start of a forward flow movement.

e. **Stop** the stopwatch the instant the **flow diversion device starts to move to the forward flow position.**

f. Record results for the office record.

g. Install and seal enclosure over the time delay relay.

Corrective Action--If the time delay is less than the minimum holding time, increase the time setting on the time delay and repeat this test procedure.

11.3 CALCULATED HOLD FOR INDIRECT HEATING

Application--To all **HHST pasteurizers using indirect heating**.

Frequency--When installed and **semiannually** thereafter; whenever seal on speed setting is broken; whenever any alteration is made affecting the holding time, the velocity of the flow, e.g., replacement of pump, motor, belt, driver or driven pulley, or decrease in number of heat-exchange plates, or the capacity of holding tube; whenever a check of the capacity indicates a speedup.

Criteria--Every particle of product shall be held for the minimum holding time in both the forward and diverted-flow positions.

Apparatus--No supplemental materials needed.

Method--Fully developed laminar flow is assumed and holding tube length is calculated. An experimental determination of pumping rate is required; this is accomplished by determining the time required for the pasteurizer to fill a vessel of known volume, converting these data by division to obtain flow rate in gallons per second, and multiplying this value by the proper number in **Table 12** in this

section, to obtain the required length of holding tube. Holding tube lengths for HHST pasteurizers with indirect heating for a pumping rate of 1 gallon/second are as follows:

TABLE 12
HOLDING TUBE LENGTH (INCHES) FOR
HHST INDIRECT HEATING PASTEURIZERS

ASSUMED PUMPING RATE = 1 GAL/SEC

HOLDING TIME (SECONDS)	TUBING SIZE (INCHES)				
	1	1 ½	2	2 ½	3
1	723.0	300.0	168.0	105.0	71.4
0.50	362.0	150.0	84.0	52.4	35.7
0.1	72.3	30.0	16.8	10.5	7.14
0.05	36.2	15.0	8.4	5.24	3.57
0.01	7.23	3.0	1.68	1.05	.71

Procedures.--

a. Examine the entire system to ensure that all flow promoting equipment is operating at maximum capacity and all flow impeding equipment is so adjusted or by-passed to provide the minimum of resistance to the flow. This means that in-line filters must be removed, booster pumps must be in operation, and vacuum equipment in the system must be operating at a maximum vacuum.

Also, before the tests are begun, the pasteurizer should be operated at maximum flow for a sufficient time to purge air from the system (about 15 minutes) and pipe connections on the suction side of the metering pump should be made tight enough to exclude the entrance of air. Increase the temperature to the

pasteurizer cut-in temperature. With the pasteurizer operating with water and in forward-flow, adjust the metering pump to its maximum capacity, preferably with a new belt and full-size impellers.

b. Determine that no flow exists in the diverted line, and **measure the time required to deliver a known volume of water at the forward-flow discharge line**. Repeat the test at least once to determine that the measurements are consistent.

c. Repeat the steps in paragraphs a. and b. of this procedure in diverted flow by measuring the flow (using identical know volume) at the discharge of the divert line.

d. Select the greatest flow rate (shortest delivery time for the known volume) and calculate the flow rate in gallons per second by dividing the known volume by the time required to collect the known volume. **Multiply this value with the appropriate value in Table 12 to determine the required holding tube length.**

e. Determine the number and type of fittings in the holding tube and convert these to equivalent lengths of straight pipe with the use of **Table 13** of this - section. Determine the total length of the holding tube by adding the equivalent lengths of the fittings to the measured straight lengths of pipe. Record the number and type of fittings, the number and length of straight pipe, and the holding tube configuration for the office record. **If the temperature sensor is located at the beginning of the holding tube, the holding tube shall be protected against heat loss by material that is impervious to water**. Reseal regulatory controls as necessary

Alternate procedure--For pasteurizers of large capacity, the method of measuring flow rate at the discharge of the pasteurizer is inconvenient, and the following alternate test procedure may be used.

TABLE 13
Centerline Distances of 3-A Fittings (Inches)

3-A Designation (90°Bend)	FITTING SIZE (Inches)				
	1	1½	2	2½	3
2C	3.4	4.8	6.2	8.0	9.7
2CG	3.1	4.5	5.8	7.6	9.3
2F	3.4	4.8	6.2	8.0	9.7
2FG	3.1	4.5	5.8	7.6	9.3
2E	3.4	4.8	6.2	8.0	9.7
2EG	3.2	4.6	6.0	7.7	9.4

Alternate procecure.--For pasteurizers of large capacity, if the method of measuraing flow rate at the discharge of the pasteurizer is inconvenient, the following alternate test procedure may be used.

1. Remove the divert line from the raw-product supply tank, and turn off the product pump feeding the raw-product supply tank.

2. Suspend a sanitary dip stick in the raw-product supply tank, and operate the pasteurizer at maximum capacity.

3. Record the time required for the water level to move between two graduations on the dip stick. The volume of water is calculated from the dimensions of the raw-product supply tank and the drop in water level.

4. Flow rate is determined as follows: Divide the volume of water removed from the raw-product supply tank by the time required to remove it.

Corrective Action--If the length of the holding tube is shorter than the calculated length, reseal the metering pump at a slower maximum speed, or lengthen the holding tube, or both, and repeat the above determination.

11.4 CALCULATED HOLD FOR DIRECT HEATING

Application--To all HHST pasteurizers using direct contact heating.

Frequency--When installed and **semiannually** thereafter; whenever the seal on the speed setting is broken; whenever any alteration is made affecting the holding time, the velocity of the flow, e.g., replacement of pump, motor, belt, driver or driven pulley, or decrease in the number of heat exchange plates, or the capacity of the holding tube; whenever a check of the capacity indicates a speedup.

Apparatus--No supplemental materials needed.

Criteria--Every particle of product shall be held for the minimum holding time in **both forward- and diverted-flow positions.**

Method--Fully developed laminar flow and a temperature increase by steam injection of 67°C (120°F) are assumed, the temperature-time standard is chosen by the processor, and the required holding tube length is calculated from an experimental determination of pumping rate.

Procedures.--

a. Examine the entire system to ensure that all flow promoting equipment is operating at a maximum capacity and all flow impeding equipment is so adjusted or bypassed as to provide the minimum resistance to the flow.

b. Remove in-line filters, make certain booster pumps are operating and that vacuum equipment in the system is operating at maximum vacuum.

c. Operate the pasteurizer on water at maximum flow for a sufficient time to purge the air from the system (about 15 minutes) and tighten pipe connections on the suction side of the metering pump to exclude entrance of air.

d. Adjust the metering pump to its maximum capacity. Determine that no flow exists in the diverted line, and **measure the time required to deliver a known volume of water at the discharge of the pasteurizer in forward flow**. Repeat the test at least twice to determine that the measurements are consistent.

e. Repeat the last step (a. above) in **diverted flow** by collecting the effluent at the discharge of the divert line.

f. Select the greatest flow rate, the shortest delivery time for the known volume, and calculate the flow rate in gallons per second by dividing the known volume by the time required to collect the known volume.

g. Multiply this value, gallons per second, with the appropriate value in **Table 14 of this paragraph to determine the required holding tube length.**

TABLE 14

Holding Tube Length, HHST

Direct Heating

HOLDING TIME-(seconds)	**TUBING SIZE (Inches)**				
	1	**1½**	**2**	**2½**	**3**
1	**810.0**	**336.0**	**188.0**	**118.0**	**80.0**
0.5	**405.0**	**168.0**	**94.0**	**59.0**	**40.0**
0.1	**81.0**	**33.6**	**18.8**	**11.8**	**8.0**
0.05	**40.5**	**16.8**	**9.40**	**5.90**	**4.0**
0.01	**8.10**	**3.36**	**1.88**	**1.18**	**0.8**

h. **Determine the number and type of fittings in the holding tube**, and convert these to equivalent lengths of straight pipe with the use of Table 13.

I. Determine the total length of the holding tube by **adding the equivalent lengths of the fittings to the measured lengths of straight pipe**. If the actual holding tube length is equivalent to or greater than the required holding tube length, record; a) the number and type of fittings, b) the number and length of straight pipes, and c) the holding tube configuration, for the office record. (Make sure that the holding tube slopes upward at least 6.35 millimeters (0.25 inch) per foot.) The holding tube shall also be protected against heat loss with insulation that is impervious to water if the temperature sensor is located at the beginning of the holding tube. Reseal as necessary.

Alternate procedure--For pasteurizers of large capacity, the method of measuring flow rate at the discharge of the pasteurizer is inconvenient, and the following alternate test procedure may be used.

a. Remove the divert line from the raw product supply tank, and turn off the product pump feeding the raw-product supply tank.

b. Suspend a sanitary dip stick in the raw-product supply tank, and operate the pasteurizer at maximum capacity.

c. Record the time required for the water level to move between two graduations on the dip stick. Calculate the volume of water from the dimensions of the raw-product supply tank and the drop in water level.

Determine flow rate as follows: Divide the volume of water, in gallons, removed from the raw-product supply tank, by the time, in seconds, required to remove it. Then use Table 14 to calculate the required holding tube length.

Corrective Action--If the length of the holding tube is shorter than the calculated length, reseal the metering pump at a slower maximum speed, or lengthen the holding tube, or both, and repeat the procedure.

11.5 HOLDING TIME--STEAM INFUSERS WITH STEAM POP-OFF VALVE AND VACUUM CHAMBER ORIFICE USED IN PLACE OF A TIMING PUMP

Application.--To all **HHST pasteurizers using direct steam infusion heating** and using a **steam pressure relief valve** and a **vacuum chamber orifice** in place of a timing pump.

Frequency.--Upon installation, and **every 3 months** thereafter, or when a regulatory seal has been broken.
Apparatus.--No supplemental materials needed

Criteria.--Every particle of product shall be held for the minimum holding time in both forward and diverted flow position.
The following controls are required:
a. **A steam infuser shell or feed line shall be equipped with a pressure relief valve**. This pressure relief valve shall be located and sized so that the total pressure insiede the infuser can never exceed the set point on this pressure relief valve.

b. **An orifice or restrictor, permanently installed in a noticeable fitting, shall be placed in the holding tube just prior to the vacuum (flash) chamber**. The opening in this orifice shall be sixed to insure a minimum product residence time at least as long as that specified in the chosen HHST standard.

c. The size of the opening in the orifice or restrictor and the setting of the steam pressure relief valve shall be determined by trial and error. Once an appropriate maximum flow rate has been determined and a legal minimum holding time has been calculated**, both the restrictor or orifice and the steam pressure setting on the pressure relief valve shall be sealed so that neither can be changed.**

d. The state regulatory authority shall keep records of the orifice or restrictor size the location, size, setting and manufacturer of the pressure relief (pop-off) valve.
Procedures.--

a. Examine the entire system to ensure that all flow promoting equipment is operating at a maximum capacity and all flow impeding equipment is so adjusted or by-passed as to provide the minimum resistance to the flow.

b. The steam pressure in the infuser shall be raised to a level just below the pressure relief point on the pop-off valve.

c. Any back-pressure valves or other variable restrictions in the holding tube shall be normally placed into the fully open position.

d. All air bleeds to the vacuum chamber shall be closed so that the chamber will be operating under maximum vacuum.

e. Before the tests are begun, operate the pasteurizer at maximum flow for a sufficient time to purge the air from the system (about 15 minutes) and tighten the pipe connections on the suction side of the metering pump to exclude entrance of air.

f. Determine that no flow exists in the diverted line, and measure the time required to deliver a known volume of water at the disharge of the pasteurizer in forward flow.

g. Repeat the test at least twice to determine that the measurements are consistent.

h. Repeat the last step (a. through e. above) in diverted flfow by collecting the effluent at the discharge of the divert line.

i. Select the greatest flow rate, the shortest delivery time for the known volume and calculate the flow rate in gallons per second, by dividing the known volume by the time required to collect the known volume.

j. Multiply this value, gallons per second, with the appropriate value in Table 14, to determine the required holding tube length.

k. Holding tube lengths for direct contact heating pasteurizers with a pumping rate of 1 gallon/second are specified in Table 14.

l. Determine the number and tupe of fittings in the holding tube, and convert these to equivalent lengths of straight pipe with the use of Table 13. Determine the total length of the holding tube by adding the equivalent lengths of the fittings to the measured lengths of straight pipe.

m. Make sure that the holding tube slopes upward at least 6.35 millimeters (0.25 inch) per foot.

n. The holding tube shall also be protected against heat loss with insulation that is impervious to water if the temperature sensor is located at the beginning of the holding tube.

o. If the actual holding tube length is equivalent to or greater than the required holding tube length, record the number and type of fittings, the number and length of straight pipes and the holding tube configuration, for the office record. Re-seal regulatory controls as necessary.

Corrective Action.--If the length of the holding tube is shorter that the calculated length, lengthen the holding tube and repeat the above determination.

TEST 12
THERMAL LIMIT CONTROLLER
FOR CONTROL-SEQUENCE LOGIC

References--Items 16p(B), 16p(E).

Thermal limit controllers used with **HHST and aseptic processing systems** that have the flow-diversion device located downstream from the regenerator and/or cooler shall be tested by one of the following applicable tests at the frequency specified.

12.1 HHST PASTEURIZATION AND ASEPTIC PROESSING-- INDIRECT HEATING

Application--To all HHST and aseptic processing systems pasteurizers using indirect heating. When testing aseptic processing systsems, the "product divert system" or "product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in thei test.

Frequency.--Upon installation, and **every 3 months** thereafter or when a regulatory seal has been broken.

Criteria.--The pasteurizer or aseptic processing equipmentshall not operate in forward flow until the product surfaces downstream from the holding tube have been sanitized or in the case of aseptic processing equipment, sterilized. On start up; surfaces shall be exposed to fluid at pasteurization or is the case of aseptic processing equipment, sterilization temperature for at least pasteurization or sterilization time. If the product temperature falls below the pasteurization or sterilization standard in the holding tube, forward flow shall not be re-achieved until the product surfaces downstream from the holding tube have been re-sanitized, or is the case of aseptic processing equipment, resterilized.

Apparatus.--A constant temperature bath of water or oil and the test lamp from the pneumatic testing device described in Test 9,1, can be used to check the control-sequence logic of the thermal limit controller.

Method.--The control-sequence logic of the thermal limit controller is determined by monitoring the electric signal from the thermal limit controller during a series of immersions and removals of the two sensing elements from a bath heated above the cut-in temperature.

Procedures.--

a. Heat a constant temperature water or oil bath a few degrees above the cut-in temperature on the thermal limit controller. Wire the test lamp in series with the signal from the **thermal limit controller to the flow-diversion device**. If some processors have time delays built into their control logic in excess of that required for public health reasons, bypass these timers or account for their effect in delaying forward flow.

b. Immerse the sensing element of the flow-diversion device in the bath, which is above the cut-in temperature. The test lamp should remain unlighted, i.e., diverted flow. Leave the sensing element in the bath.

c. Immerse the sensing element from the holding tube in the bath. The test lamp should light up, i.e., forward flow after a minimum time delay of 1 second for continuous flow pasteurizatin systems. For aseptic processing systems, no delay is required if the filed process includes a documented sterilization period.

d. Remove the sensing element of the flow-diversion device from the bath. The test lamp should remain lighted, i.e., forward flow.

e. Remove the holding tube sensing element from the bath. The test lamp should go out immediately, i.e., diverted flow.

f. Re-immerse the sensing element of the holding tube in the bath. The test lamp should remain unlighted, i.e., diverted flow. Re-seal regulatory controls as necessary.

Corrective Action--If the control-sequence logic of the thermal limit controller does not follow this pattern, the instrument shall be rewired to conform to this logic.

12.2 HHST PASTEURIZATION AND ASEPTIC PROCESSING SYSTEMS-- DIRECT HEATING

Application--To all HHST pasteurizers and aseptic processing systems using direct contact heating. When testing aseptic processing systsems, the "product divert system" or "product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in thei test.

Frequency--Upon installation, and **every 3 months** thereafter and when a regulatory seal has been broken.

Criteria--The pasteurizer or aseptic processing equipmentshall not operate in forward flow until the product surfaces downstream from the holding tube have been sanitized or in the case of aseptic processing equipment, sterilized. On start up; surfaces shall be exposed to fluid at pasteurization or is the case of aseptic processing equipment, sterilization temperature for at least pasteurization or sterilization time. If the product temperature falls below the pasteurization or sterilization standard in the holding tube, forward flow shall not be re-achieved until the product surfaces downstream from the holding tube have been re-sanitized, or is the case of aseptic processing equipment, resterilized.

Apparatus--A constant temperature bath of water or oil and the test lamp from the pneumatic testing device described in Test 9,1, can be used to check the control-sequence logic of the thermal limit controller.

Method.--The control-sequence logic of the thermal limit controller is determined by monitoring the electric signal from the thermal limit controller during a series of immersions and removals of the three sensing elements from a bath heated above the cut-in temperature.

Procedures.--

a. Heat a water or oil bath to a constant temperature, a few degrees above the cut-in temperature on the thermal limit controller. Wire the test lamp in series with the signal from the thermal limit controller to the flow-diversion device. If some processors have time delays built into their control logic in excess of that required for public health reasons, bypass these timers or account for their effect in delaying forward flow. Before performing this test, make sure the pressure switches which must be closed to achieve forward flow have also been bypassed.

b. Immerse the sensing element from the flow-diversion device in the bath which is above the cut-in temperature. The test lamp should remain unlighted, i.e., diverted flow. Remove this sensing element from the bath.

c. Immerse the sensing element from the vacuum chamber, in the bath. The test lamp should remain unlighted, i.e., diverted flow. Remove the sensing element from the bath.

d. Immerse two sensing elements, from the vacuum chamber and flow-diversion device, in the bath. The test lamp should remain unlighted, i.e., diverted flow. Leave the two sensing elements in the bath.

e. Immerse the sensing element from the holding tube in the bath. The test lamp should light up, i.e., forward flow after a minimum time delay of 1 second for continuous flow pasteurizatin systems. For aseptic processing systems, no delay is required if the filed process includes a documented sterilization period.

f. Remove one sensing element, the flow-diversion device, from the bath. The test lamp should remain lighted, i.e., forward flow.

g. Remove another sensing element, the vacuum changer, from the bath. The test lamp should remain lighted, i.e., forward flow.

h. Remove the last sensing element, the holding tube, from the bath. The test lamp should go out, i.e., diverted flow, immediately.

I. Re-immerse the sensing element, holding tube, in the bath. The test lamp should remain unlighted, i.e., diverted flow. Re-seal regulatory controls as necessary.

Corrective Action--If the control-sequence logic of the thermal limit controller does not follow the pattern set out in the procedures section, the instrument shall be rewired to conform to this logic.

TEST 13
SETTING OF CONTROL SWITCHES FOR PRODUCT PRESSURE IN THE HOLDING TUBE

Reference-- Item 16p(B).

Application--To all HHST pasteurizers and aseptic processing systems which are capable of operating with product in forward flow mode, with less than 518 kPa(75 psig) pressure in the holding tube. When testing aseptic processing systsems, the "product divert system" or "product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in thei test.

Frequency--Upon installation, and every 3 months thereafter; whenever the pressure switch seal is broken; and whenever the operating temperature is changed.

Criteria--The pasteurizer or aseptic procesor shall not operate in forward flow unless the product pressure in the holding tube is at least 69 kPa (10 psi) above the boiling pressure of the product.

Apparatus--A sanitary pressure gauge and a pneumatic testing device described in Test 9,1, can be used for checking and adjusting the pressure switch setting.

Method--The pressure switch is checked and adjusted so as to prevent forward flow unless the product pressure in the holding tube is at least 69 kPa (10 psi) above the boiling pressure of the product.

Procedure.--

1. From Figure 40, determine the pressure switch setting necessary for the operating temperature (not the diversion temperature) being used in the process.

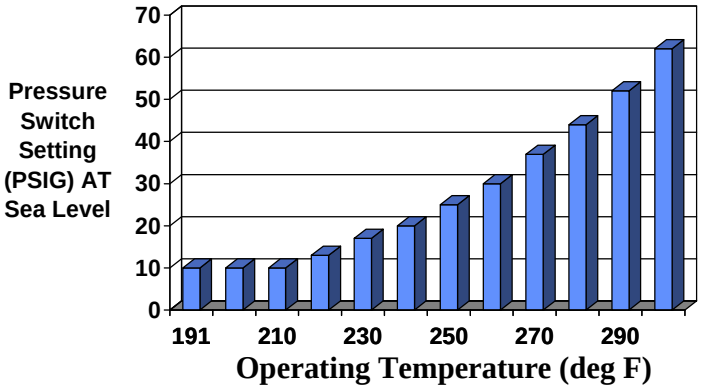
2. Install the sanitary pressure gauge of known accuracy and the pressure switch sensing element on the pneumatic testing device.

3. Remove the seal and cover to expose the adjustment mechanism on the pressure switch.

4. Place the test lamp in series with the pressure switch contacts or use some other method to monitor the cut-in signal.

5. Apply air pressure to the sensing element, and determine the pressure gauge reading at the cut-in point of the switch which will light the test lamp. If the switch is short circuited, the lamp will be lighted before air pressure is applied.

Table 40-Pressure Switch Settings



6. Determine that the cut-in pressure on the switch is equivalent to or greater than the required pressure from Figure 40. Where adjustment is necessary, refer to manufacturer's instruction. After adjustment, repeat the procedure set out in this paragraph.

7. When the results are satisfactory,seal the pressure switch setting and record the results for office record. For each operating temperature on HHST pasteurizers using direct contact heating, the product pressure switch setting is determined from Table 40.
Note: *The pressure setting shall be adjusted upward by the diffierence between local normal atmoshperic pressure and at sea level.*

TEST 14
SETTING OF CONTROL SWITCHES FOR DIFFERENTIAL PRESSURE ACROSS THE INJECTOR

Application--To all HHST pasteurizers and aseptic processing systems using direct contact heating. When testing aseptic processing systsems, the "product divert system" or "product divert valve" or "acceptable control system" may be substituted for the "flow-diversion device" when it is referenced in thei test.

Frequency--Upon installation, **every 3 months** thereafter and whenever the differential pressure controller seal is broken.

Criteria--The pasteurizer or aseptic processor shall not operate in forward flow unless the product pressure drop across the injector is at least .7 KPA (10 psi).

Apparatus--A sanitary pressure gauge and a pneumatic testing device described in Test 9,1, can be used for checking and adjusting the differential pressure controller.

Method--Check the differential pressure switch and adjust it so as to prevent forward flow unless the differential pressure across the injector is at least 69 kPa (10 psi).

Procedure.--

1. Remove both pressure sensing elements from their original locations on the pasteurizer or aseptic processor.

2. Install the sanitary pressure gauge of known accuracy and the pressure sensing element that is installed prior to steam injection on the pneumatic testing device. Leave the other pressure sensing element open to the atmosphere but at the same height as the sensing element connected to the pneumatic testing device.

3. Wire the test lamp in series with the micro switch of the differential pressure controller or use the method provided by the instrument manufacturer to monitor the cut-in signal.
4. Apply air pressure to the sensing element and determine the pressure gauge reading at the cut-in point of the differential pressure switch that will light the test lamp. Determine that the differential pressure cut-in on the controller is at least 69 kPa (10 psi). Note: *this test is to assure at least a 10psi pressure loss of product at exit end of the steam injector.This assures complete condensation of the steam within the injector*.

5. After adjustment, repeat the procedure.

6. When the results are satisfactory, seal the instrument and record the results for the office record.

Testing of micro-processor STLR's

Testing the AV-9900 HTST Recorder Controller

The STLR functions the same as the existing Anderson EHT-700, as it utilizes a dual element RTD with an internal comparator to insure failsafe operation.

Program/Run Selection - All tests may be performed with the unit sealed and in the "Run" moe. In order to make adjustments to any settings other than pen accuracy, the chart plate seal must be removed and the internal sedurity "shunt" must be moved from the "run" (upper) position to the "program" (lower) position. This shunt is located on the STLR "interconnect" board in ht e lower left hand corner of the instrument. It is labeled JU1 and is positioned 1 inch below the upper right corner of the board. For program mode, position the shunt on the lower two pins. For run mode, move it up one position. The unit will only operate in run mode. Finally, during initial installatin, make a note of the labels on the EEPROM chips labeled U7 and U8 inside the unit before applying the health authority seal.

Test 2 and 4: Temperature Accuracy

This is the only health code related function that can be adjusted I the "run" mode. It allows the operator or health authority to adjust the pen to agree with a verified indicating thermometer.

After testing the accuracy using the PMO procedure adjust the recording pen to agree with the verified indicating thermometer as follows:

1. Press the scroll key on the keypad (just to the right of the ESC key). The display will read:
   SELECT (-)
   FUNCTION SETUP

2. Press the DOWN arrow key. Use the scroll key until STLR flashes on the display.

3. Press the unlabeled button under the flashing STLR display. The display will read: STLR INP DISPLAY OPT

4. Press the Scroll Key until the display reads:

   STLR INP CORRECTION

   .____F (or C)

To properly test for response time, simply start the stopwatch when the display reads a temperature 12 degrees below the cut-in temperature. If the display moves too quickly or "skips" over the start temperature, you may start the watch at a temperaure 2-3 degrees below the desired temperaure. The result should be well within the 5 second maximum. Stop the watch when the display changes from:

"STLR OUR OFF" to "STLR OUT ON"

Test 10: Milk Temperature at Cut-in and Cut-out.

These tests may be performed as outlined in the PMO. If a change is required to the cut-out temperature or to the amoujnt of dead-band between cut-in and cut-out, proceed as follows:

1. Remove the regulatory seal and open the chart plate. Reposition the security shunt to the "Program" mode as outlined above.

2. Press the SCROLL Key until the display reads:
   SELECT (-)
   CONTROLLER SETUP

3. Press the the DOWN Arrow Key. STLR will be flashing in the lower left display.

4. Press the button below the flashing STLR.

5. Press the scroll key until the display reads the appropriate set point (1 thru 5). The displayed setpoint is the cut-out value. If you wish to change the setting, press the MOD Key. This will underline the value. Then use the UP/DOWN keys to modify.

6. Press the ENTER KEY to program the new value.

7. Press the skoll dey again to display the aount of deadband between Cut-in and Cut-out for that set point. Each set point will have its own deadband. Press MOD Key and then use the UP/DOWN Keys to modify.

8. Press the ENTER Key to program the new value.

9. Press the RESET Key.

10. Re-position the security shunt to the run (upper) position. Verify that EEPROM's U7 and U8 are labeled as noted during initial installation. Re-seal the chart plate.

Test 3: Time Accuracy

With the unit in the "Run" mode and while a chart is being printed, use an accurate watch to test for time accuracy as follows:

1. Begin timing when the unit prints a major time line (solid color).

2. Stop timing when the mechanism prints the second minor time line (second dotted line). The elapsed should be 30 minutes.

Test 8: Thermometric Response

The standard test may be used except theat the display must be utilized to start the stopwatch at eh proper temperature. If the display has been configured to opeate in the seuintial mode, the test will be simplified by first programming it to display in the continuous mode as follows:

1. Wait until the display reads
   STLR INP
   STLR OUT

   Press the DISP Key twice. The display will read:
   MODIFY
   DISPLAY PARAMETERS

2. Press the DOWN Arrow Key. The display will read:
   DISPLAY MODE
   CONTINUOUS SEQUENCE (flashing)

3. Press the Scroll Key. Now CONTINUOUS will be flashing

4. Press the ENTER Key and then RESET Key. The display will now continuiusly display the STLR Temperature constantly. Just below this line on the display will be the status of the STLR Output. ("STLR OUT OFF" signifies a temperature below Cut-In). After completion of this test, use the same procedure to return the unit to sequential display.

TESTING THE ELECTRONIC RECORDER-CONTROLLER(Early type)

The four test required for Electronic recorder controllers (ERC's) are:

A. Programming of process values (upon initial installation or when a change in the process is made)

B. Instrument calibration (quarterly)

C. Cut-in and cut-out temperatures (quarterly, daily by the operator)

D. Locking and sealing of instrument (quarterly)
Tests A, B, and C are also to be conducted when Test 1 is performed.

TEST A - PROGRAMMING OF PROCESS VALUES

APPLICATION - To all Taylor ER/C Recorder-controllers used in connection with continuous flow pasteurizers.

FREQUENCY - Upon installation and whenever a process value needs to be changed.

CRITERIA - The selected process variables shall be programmed with the values stated in this test.

APPARATUS -none

METHOD - The regulatory official shall scan through the display prompts of the firmware for the recorder controller according to the vendor's operations manual and program the appropriate process values for HTST operation.

Taylor ERC (First Model) Testing

PROCEDURE 1 - With the power off to the recorder-controller, open the back case and move the control switch to the unlocked (run) position. Close the recorder-controller and turn on power.

Set the following process values:

2. Move display prompt to Level 2 CH.Lo (chart low). Set process value at 120° F.*

3. Move display prompt to Level 2 CH.H1 (chart high). Set process value at 220° F.*

4. Move display prompt to Level 2 deG.C. Set process value as "no" (Fahrenheit temperature scale selected).

*Note: These process values are for chart No. 500P1225-35, with low and high limits of 120° F and 220° F. If a different chart is used, the low and high limits of that chart must be used. If a different chart is used, it must meet the specifications of Appendix H.

5. Move the display prompt to Level 2 FILt. Set process value as no (chart damping filter disabled).

6. Move display prompt to Level 2CHrt SPed. Set process value at 12 (chart rotation period in hours).

7. Move display prompt to Level 3 ALr.H. Set process value at 220° F or the maximum temperature on the chart (high alarm set point).

8. Move display to Level 3 ALr.lH. Set process value at least o,5° F higher than the minimum pasteurization temperature (low alarm set point).

9. Move display prompt to Level 3 A.HYS. Set process value at 1° F (alarm hysteresis which determines the difference between cut-in temperature and cut-out temperature).

10. Move display prompt to Level 3 ACK. Set process value as no (deletes acknowledge routing to level 1).

11. Move display prompt to Level 4 CAL.H (calibrate all pens to the outer edge of the chard). Observe that the recording pen and event pen drop to the outer temperature line on the chart. If the pens do not, plant personnel or the instrument vendor would make the appropriate adjustment.

12. Move display prompt to Level 4 CAL.L (calibrate all pens to the inner edge of the chart). Observe that the recording pen and the event pen drop to the inner temperature line on the chart. If the pens do not, plant personnel or the instrument vendor should make the appropriate adjustment.

13. Move display prompt to Level 5 t.CAL: then, attempt to move display prompt to Level 6. If a Level 6 can be accessed on the recorder-controller, the instrument contains a RS-422 Communications Port which permit the process values to be changed after the instrument is sealed

CORRECTIVE ACTION - If the process values cannot be set as described in this test, contact the vendor for repairs or further operating instructions. If Level 6 can be accessed, contact the vendor to remove the RS-422 Communications Port.

TEST B - Recorder-Controller Calibration

APPLICATION - To all Taylor ER/C recorder-controllers used in connection with continuous flow pasteurizers.

FREQUENCY - Upon installation and every three months thereafter.

CRITERIA - The recording thermometer shall not read higher than the corresponding indicating thermometer. This test must be conducted before the test for cut-in and cut-out temperatures.

APPARATUS - Indicating thermometer that has been calibrated with a thermometer traceable to or certified by the National Bureau of Standards, and a water or oil bath with a control system capable of maintaining a mean bath temperature of 0.5^{o} F (plus or minus).

METHOD - The indicating thermometer and the sensing element for the recorder-controller are immersed in the circulating water or oil bath. The temperature reading from the recording pen is compared to that from the indicating thermometer and adjusted, if necessary.

PROCEDURE 1 - Adjust the water or oil bath to a temperature that is approximately 2^{o} F above the diversion temperature. Sufficient agitation and/or circulation is needed to maintain a uniform bath temperature.

2. On the Taylor ER/C recorder-controller, move display prompts to Level 5 PEn.1 t. CAL (pen 1 temperature calibration).

3. Immerse the indicating thermometer and the sensing element of the recorder-controller to their appropriate immersion levels in the water or oil bath. Allow three or four minutes for the bath temperature to regain equilibrium.

4. Record the temperatures shown on the indicating thermometer, digital display on the recorder-controller, and the recording pen for the office record.

CORRECTIVE ACTION - If the digital display or the recording pen (both on the recorder-controller) read higher than the indicating thermometer, adjust the calibration factor of the recording pen so that they do not read higher than the indicating thermometer. Record the calibration factor for the office record.

TEST C - Taylor ER/C recorder-controller Cut-in and Cut-out temperatures.

APPLICATION - to all Taylor ER/C recorder-controllers used in connection with continuous flow pasteurizers.

FREQUENCY - Upon installation and once every three months thereafter.

CRITERIA - Forward flow cannot occur until the minimum pasteurization temperature has been reached. Diverted flow must occur before the temperature drops below the minimum pasteurization temperature.

APPARATUS - Indicating thermometer that has been calibrated with a thermometer traceable to or certified by the National Bureau of Standards, and a means of changing temperature in the holding tube, or water bath, or oil bath at a rate not exceeding 1^{o} F every 30 seconds.

METHOD - Observe the actual temperature of the indicating thermometer at the instant the flow diversion device moves to the forward flow position (cut-in) and the flow diversion device moves to the diverted flow position (cut-out).

PROCEDURE - Same as for conventional STLR

CORRECTIVE ACTION - If the cut-in or cut-out temperature is lower than the minimum pasteurization temperature, raise the low alarm setting on the ER/C recorder-controller according to the procedures outlined in Test A (Programming of Process Values). Repeat the test.

TEST D - LOCKING AND SEALING OF INSTRUMENT

APPLICATION - To all earlier model (not for 5100 series Commadore models) Taylor ER/C recorder-controllers used in connection with continuous flow pasteurizers.

FREQUENCY - Upon installation, every three months thereafter, and whenever a process value is changed.

CRITERIA - The process values are programmed, locked with the values stated in this test, and finally the locking mechanism is sealed by the regulatory official.

APPARATUS - none

METHOD - The regulatory official shall lock the process values programmed into the firmware and then seal the back panel of the recorder-controller. The regulatory official shall also confirm that the process values, once locked and sealed, cannot be changed by plant personnel without breaking the seal.

PROCEDURE 1 - After all the required tests are satisfactorily completed, open the back panel of the recorder-controller and move the control switch (run or lock) to the locked position (see vendor's operation manual). Close the recorder-controller panel.

2. Move the display prompts through the following Level - positions to confirm the programmed process values, and attempt to alter them (see vendor's operations manual).

a) Level 2 CH.Lo (chart low) - 120^{o} F
b) Level 2 CH.HI (chart high) - 220^{o} F
c) Level 2 dEG.C (Celsius temperature scale selected) -no
d) Level 2 FILt (chart damping filter enabled) - no
e) Level 2 CHrt SPed (chart Speed) - 12 hrs
f) Level 3 ALr.H (high alarm set point) - 220^{o} F
g) Level 3ALr.L (low alarm set point) - 0.5^{o} F above minimum pasteurization temperature or higher.
h) Level 3 A.HYS (hysteresis) - 1^{o} F
i) Level 2 ACK (alarm acknowledge routing to Level 1) - no
j) Level 5 PEn.1 t.CAL (recording pen calibration factor) - same value as determined in Test B.

3. Record programmed process values for the office record.

4. Seal the back panel on the recorder-controller.

CORRECTIVE ACTION - If any of the programmed process values can be altered (see vendor's manual) with the control switch in the locked position, contact the vendor for repairs or replacement of the recorder-controller. If any of the programmed process values (a. through j.) do not have the values shown in this test, repeat Test A.