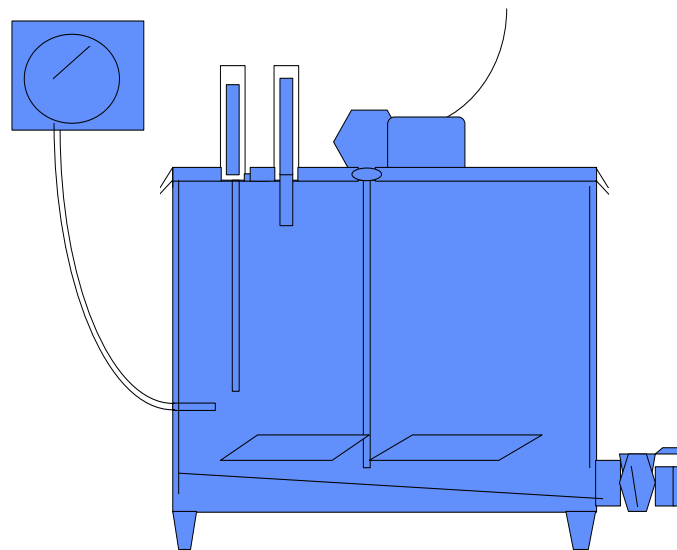


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Chapter II

VAT PASTEURIZATION





VAT PASTEURIZATION


VAT PASTEURIZATION


PURPOSE: To understand the basic principles, and public health reasons for the requirements of proper design and operation of a batch type or vat pasteurizer.

OBJECTIVES:

-  . To understand and be able to list and explain the compliance and construction requirements of a vat pasteurizer.

-  . To list the correct operational methods of a vat pasteurizer.

-  . To be able to describe and perform all required regulatory tests for a vat pasteurizer.

-  . Know and be able to list the **CRITICAL CONTROL POINTS** of a vat pasteurizer.

GENERAL DISCUSSION

The heating of milk in a vessel has long been one of the most effective methods of rendering a relatively organism free and hopefully pathogen free milk product.

The product is heated in a **jacketed stainless steel vat** which has been fitted with water and steam to the jacket liner, **thermometers** to monitor and record product temperatures, and some means of **agitation** to assure uniformity in temperature distribution. Other requirements include properly designed **valves**, time/temperature requirements, and **methods of operation** which will be discussed in this chapter.

VAT PASTEURIZATION

Generally, we can say that all vat or batch type pasteurizers should conform to "The 3-A Sanitary Standards for Non-Coil Type Batch Pasteurizers for Milk and Milk Products", Number 24-01. This standard provides guidelines for the installation, approved materials, finish, and fabrication of vat pasteurizers. Also all vat pasteurizers must comply with Item 16p(A) of the PMO, including all operational and construction requirements.



VAT PASTEURIZATION

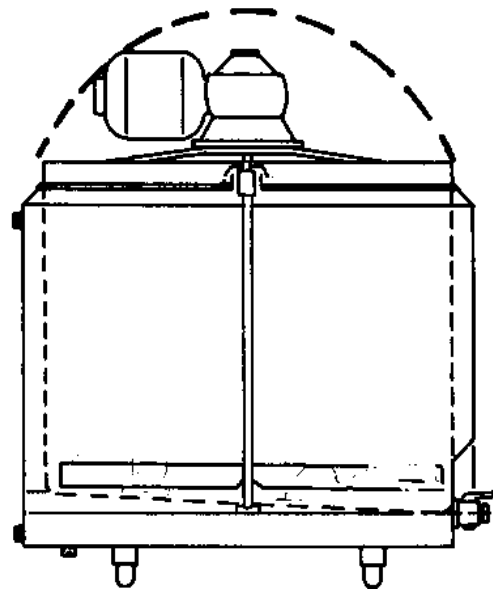
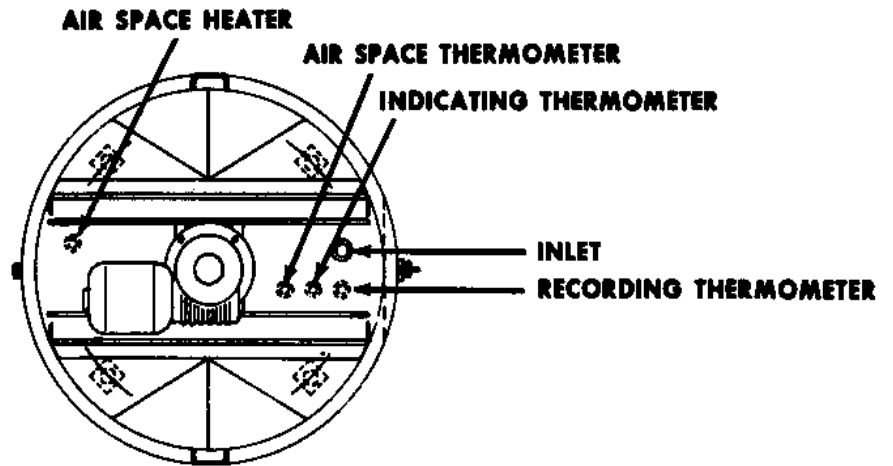
VAT PASTEURIZATION-CRITICAL CONTROL POINTS

- ✓ *TIME AND TEMPERATURE REQUIREMENTS MET*
- ✓ *NO TEMPERATURE ABUSE*
- ✓ *COVERS IN PLACE DURING OPERATION*
- ✓ *VAT CONSTRUCTION WITHIN COMPLIANCE*
- ✓ *AGITATION DURING OPERATION*
- ✓ *NO INGREDIENTS ADDED AFTER PASTEURIZATION*
- ✓ *PRODUCT PROTECTED AFTER PASTEURIZATION*

VAT PASTEURIZATION

Figure 1

Schematic of a Vat Pasteurizer



BATCH PASTEURIZER CONSTRUCTION STANDARDS



1. **Valves** - Outlet valves must comply with the close coupling standards established by the 3-A Standards.

a. The valves must be constructed of **solid stainless steel** to permit adequate heat transfer to the inner portions of the valve and so designed as to prevent the accumulation of unpasteurized milk in the milk passages of the valve when the valve is in a closed position.

b. All outlet valves must be of the **leak protector type**, which are designed to prevent leakage of raw milk past the valve body. The leak detector groove must be at least 3/16 inch in width and 3/32 minimum depth at the center to prevent clogging. (Note - presently there are no air operated valves acceptable for use as vat pasteurizer outlet valves).

A limited number of cone bottom tank protector type valves were fabricated; however their current availability is extremely limited. These valves are designed with spiral shaped grooves designed which expel any leakages past the valve seat to the floor. If cone bottom vats are utilized as vat pasteurizers special consideration should be given to proper product agitation capabilities and other construction requirements of these type vats.

c. All vat pasteurizer outlet valves must be fitted with **stops** which provide the operator with a physical indication of complete valve closure during the entire filling, heating, and pasteurization holding period operation.

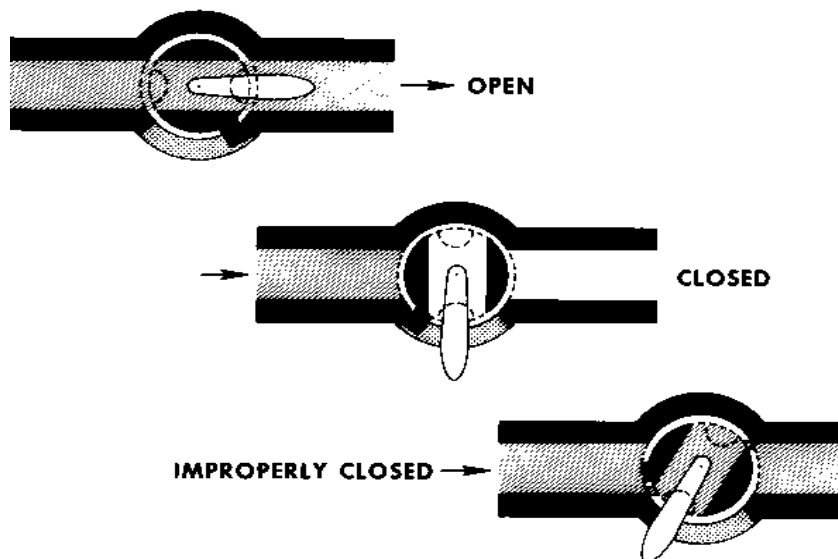
d. Outlet valves must be of the **close coupled** design; that is, designed so as to prevent the accumulation of unpasteurized milk in the milk passage of the valve when in the closed position.

VAT PASTEURIZATION

e. All vats used for pasteurization must be fitted with adequate means of continuous mechanical agitation.

f. The requirements outlined in Ma-76 prohibits the practice of leaving the raw milk fill line to remain in place in the vat pasteurizer during the holding time phase since complete separation between raw and pasteurized milk product is required at all times.

g. Outlet valves which are mounted vertically, as on cone bottom vats, must have a leak detector groove arrangement which will allow free drainage of any product past the plug while in the closed position. Grooves must be curved or placed at such an angle to accomplish proper draining. Diagrams of these valves may be found in the 3-A Standard 08-17, Part 2, drawings 100-28 and 100-29.



IMPORTANCE OF PROPER STOPS ON PLUG VALVES

Figure 2

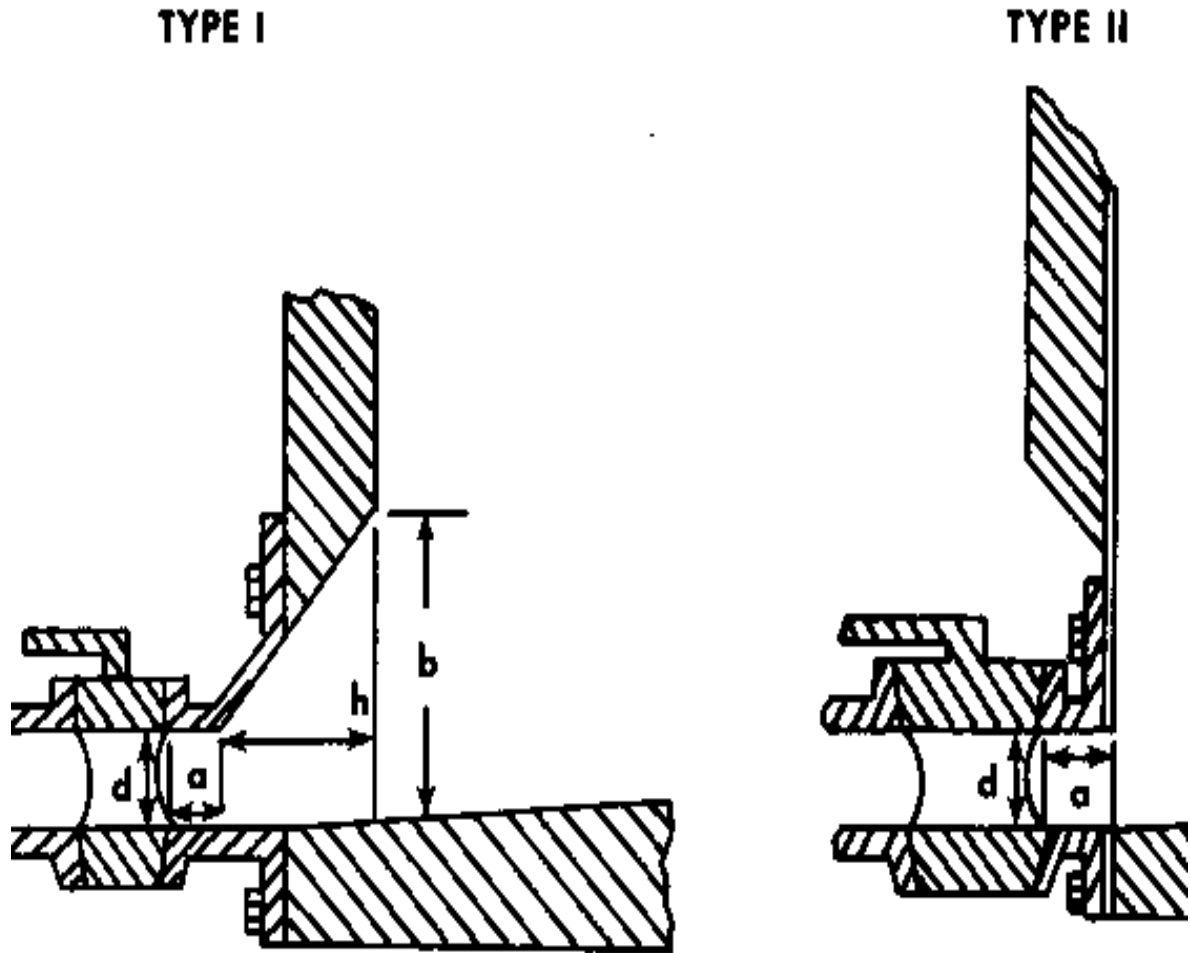


Figure 3
Close Coupled Outlet Valves

VAT PASTEURIZATION

2. Covers

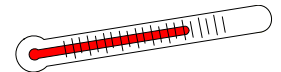
- a. All openings must be provided with covers constructed to prevent the entrance of surface contamination or foreign material. The main cover or lid shall be designed to remain in the open position (to facilitate processing and/or cleaning), and shall be sufficiently rigid and self draining. The main lid shall be designed so that raising will not allow any liquid or other contamination to enter the pasteurizer.
- b. Openings in the tank or vat cover must be equipped with raised edges to prevent surface drainage into the milk.
- c. The vat cover and any opening into the tank interior must have **overlapping** or "shoe box" type edges. The covers must be relatively close fitting and overlap the opening.
- d. All pipe, thermometer, agitator shafts, or other appurtenances that extend down into the vat **must do so only through condensation diverting aprons** unless a water tight joint is used.

3. Agitators

- a. All vats used for pasteurization **must be equipped with a mechanical means** of assuring that each and every particle of milk is heated. This is accomplished by **mechanical/electrical motor driven agitators**. The most efficient agitators will be designed to push the product down and sweep the product across the heat exchange surface on the sides and bottom of the vat. Agitators shall be designed to result in uniform product and temperature throughout the vat. Product temperatures variances **must not exceed 1°F** between any two points within the vat at any time during the holding period.
- b. Agitators must meet construction criteria for **milk contact surfaces** and be designed to be easily cleanable and/or removable for manual cleaning.

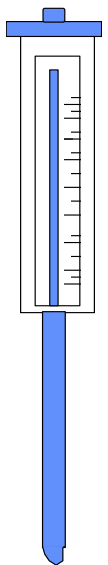
VAT PASTEURIZATION

- c. Agitator shafts must be fitted with effective **drip deflection shields** to prevent contamination of the milk.
- d. Agitator shaft openings shall have a minimum diameter of one inch to allow for **removal and cleaning of the agitator shaft**.
- e. The annular space around the agitator shaft shall be fitted with an umbrella or drip shield of sanitary design to protect against the entrance of contaminants.



4. Indicating and Recording Thermometers

- a. Indicating thermometers shall be of the **mercury actuated, direct-reading type**, scaled to a minimum of 0.625 of an inch, with a span of not less than 25 degrees F which includes the pasteurization temperature (plus or minus 5° F) and graduated in 1° F, and accurate to within 0.5° F. Provided that electronic RTD direct reading type thermometers that meet the requirements and are acceptable to FDA may be used as indicating thermometers on batch type pasteurizers.
- b. The sensing bulb of the indicating thermometer (official thermometer) must be designed to **extend fully into the product during pasteurization**.
- c. Each vat pasteurizer must be provided with an approved **air space thermometer**. The air space thermometer must meet the same general requirements of the indicating thermometer with exception of the bulb length, degree increments, and accuracy requirements.



VAT PASTEURIZATION

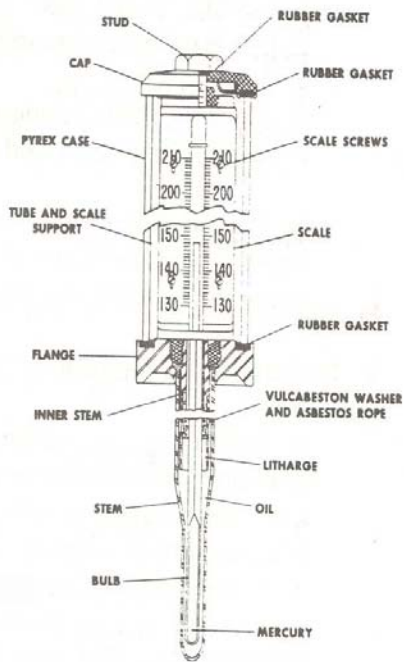
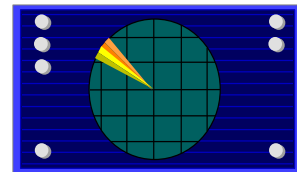


Figure 4 - Indicating Thermometer



The bottom of the bulb chamber for air space thermometers must not be less than 2 inches nor more than 3.5 inches below the underside of the top enclosure, bridge, or cover. The bottom of the bulb must never be less than 1 inch from the top surface of the product during pasteurization. The air space thermometer may be graduated in 2 degree maximum increments and must be accurate to plus or minus 1 degree F.

VAT PASTEURIZATION

d. Each vat must also be equipped with a **recording thermometer**. This thermometer must be graduated in 1° F increments between 140° F and 155° F.

The chart must be graduated in time scale divisions of not more than **10 minutes** for a maximum record of 12 hours and must be specifically designed (and so identified) for the type of recorder being used.

e. On those vats used **solely** for pasteurizing at temperatures greater than 160° F, the recording chart may be graduated in 1° C (2° F). The 1° C (2° F) increments shall be in the 150° to 170° F range. On these type vats, the chart may be graduated in **15 minutes** for a maximum of 24 hours.

The recorder device may be either electric or spring driven.

Required recorder chart information (for each product batch):

- 1) Name of milk plant.
- 2) Date.
- 3) Signature or initials of the operator.
- 4) Identification of the recorder when more than one vat is
- 5) Record of holding time including empty and fill times as
- 6) Reading of air space thermometer at the beginning of the
- 7) Reading of indicating thermometer at an indicated point
- 8) Amount and name of product represented by each batch.
- 9) Record of any unusual occurrences.

Charts shall be retained for 3 months.

VAT PASTEURIZATION

1992						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

1992						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

1992						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

VAT PASTEURIZATION

5. Air space heaters may be necessary to maintain minimum air space temperatures. These devices must be of sanitary design, meet all 3-A Sanitary requirements, including installation and culinary steam requirements. The air space heater must be easily demountable for cleaning (See Appendix H of the PMO, for culinary steam requirements or Figure 5 below.)

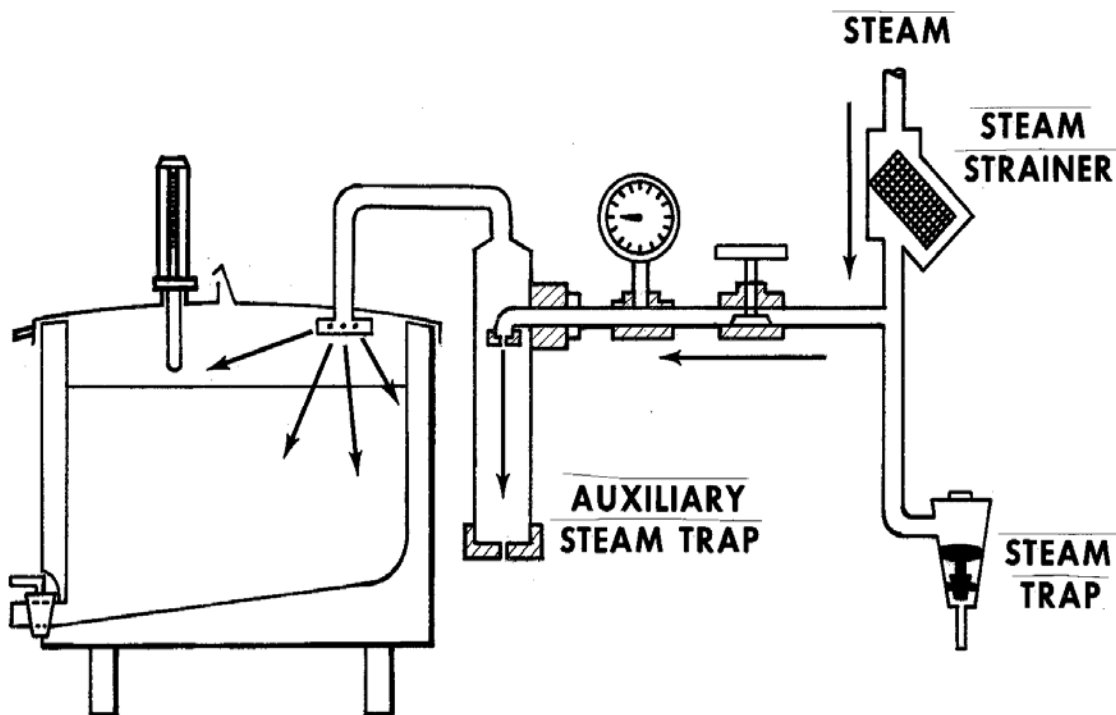


Figure 5
Air Space Heating

VAT PASTEURIZATION

BATCH PASTEURIZER OPERATING STANDARDS

1. All product components must be added to the batch **prior to beginning the pasteurization process**. This includes any liquid sugar and sweeteners, water, milk powders and all other dairy products, flavorings, stabilizers, cocoa products, emulsifiers, and vitamins.

There are certain flavoring ingredients that may be added **after** pasteurization. These include flavoring ingredients having an a_w of 0.85 or less, high acid content, dry sugars, fruits and roasted nuts, safe and suitable bacterial culture organisms, and flavorings containing a high alcohol content. Fruits and vegetables may be added to cultured products having a pH of 4.7 or less.

Such ingredients addition shall be done in a sanitary manner and the ingredients must be of a safe and wholesome quality.

2. Pasteurization must be performed in equipment which is properly designed and operated, and which insures that every particle of product will be held **continuously** for the minimum time and temperature. Vats should be designed so that product can be heated to pasteurization temperatures **in as short a time as practicable**. **In no case should this time exceed 4 hours**. Following pasteurization the product must be cooled to $<45^{\circ}$ F as soon as possible. The only exception for this cooling requirement is for cultured products processing.

3. If for any reason the vat lid or any cover is lifted or mechanical failure of any kind (agitator malfunction, loss of temperature below the required minimum, etc) occurs after beginning of the pasteurization cycle, **the timing process must be restarted and notes to that effect must be made on the recording chart** by the operator.

VAT PASTEURIZATION

4. The official thermometer is the indicating thermometer and the recording thermometer functions to only provide a record of the pasteurization cycle. For each product batch the operator is required to verify the accuracy of the recording thermometer using the indicating thermometer as the standard. This comparison is noted on the recording thermometer chart. **No batch of milk shall be pasteurized unless the sensors of both thermometers are covered.**

5. The air space thermometer reading must also be recorded on the recording chart during pasteurization. To assure that the minimum air space temperatures are being maintained, the air space indicating thermometer shall be read and recorded at the **beginning** of the holding period. It is also strongly recommended that the air space temperatures be noted and recorded **during and at the end of the holding period**. During pasteurization, the air space temperature must never be less than 5°F above the minimum legal pasteurization temperature required for the milk product contained in the vat.

6. Recording charts must be used only for the length of time for which it has been designed. **Overlapping of information on circular charts is never acceptable and is a violation of the PMO. Required information on the recording chart must be legible and meet all the requirements as spelled out in the PMO.**

7. The outlet valve is designed to detect and expel any leakage past the valve seat and is close coupled to prevent cold pockets of milk from accumulating in the valve or piping.

8. At no time during the pasteurization cycle or following pasteurization may the outlet piping be directly attached to any line or vessel containing raw milk or any other contaminating substance.

VAT PASTEURIZATION

ASSURANCE OF HOLDING PERIODS

1. Vats must be operated so that every particle of milk is held for **at least 30 minutes** at or above the minimum required temperature for the specific product processed.
2. When the milk product is heated to pasteurization temperature **in the vat and is partially cooled in the vat** before opening the outlet valve, the recorder chart must show at least 30 minutes at or above the minimum pasteurization temperature.
3. When the milk product is **preheated** to pasteurization temperature prior to entering the vat, the recorder chart **must** show a holding time of 30 minutes **plus the filling time of the vat from the level of the recorder bulb sensor to the maximum level of normal operation (pasteurization)**.
4. When **cooling is begun after the outlet valve is opened** or is done entirely outside the vat, **the chart must show a holding time of 30 minutes plus the time necessary to empty the vat to the level of the recording thermometer bulb**.
5. These filling and/or emptying times **must be indicated on the chart by the operator** by inscribing the start and end of the official 30 minute holding time.
6. Upon close inspection, vat pasteurization recording charts used that have been used must show clearly the four identifying holes (marks) which verify the chart has not been rotated or manually turned to give a false time line accuracy.

VAT PASTEURIZATION

VAT PASTEURIZATION

CHAPTER REVIEW

1. The requirements for vat pasteurization may be found in Section ____, Item _____ on pages _____ of the current edition of the _____.
2. Another good reference for vat pasteurizers may be found in: _____.
3. Currently vat pasteurizers found in many modern processing plants are used for products such as _____.
4. Batch Pasteurization Time Temperature Standards:

<u>Product</u>	<u>Temperature</u>	<u>Time</u>
Whole Milk	_____	_____
Skim Milk	_____	_____
Half and Half	_____	_____
Eggnog	_____	_____
Frozen Dessert Mix	_____	_____

5. The PMO requires that if the fat content of the milk product is _____ percent or more, or if it contains added sweeteners or solids, the specified minimum temperature shall be increased by _____ degrees F.
6. The FDA Dairy, Inc, vat pasteurizes their cheese milk at 173° F. The operator Mr. I.M. Messed Up must always check to make sure that the air space temperature reads at least _____ ° F during the entire holding time.
7. What is the purpose of VALVE close coupling?
8. You are the night manager of a large milk processing plant. The vat pasteurizer

VAT PASTEURIZATION

operator notifies of the following:

CONDITION

YOUR SOLUTION

- a) He forgot to add dry sugar to the mix prior to pasteurization, however did add the sugar at only five minutes into the beginning of the 30 minute time and then added 25 minutes to the time after adding the sugar. The mix was packaged last night and is ready for shipment.

- b) The air space thermometer was damaged and the mercury slightly separated, however since the milk was pasteurized at 170 degrees he had decided to package the product and was delivered this morning to the store.

- c) The boiler lost steam pressure during pasteurization, but since the temperature never got below 145, the cream was packaged and in the plant cooler anyway.

- d) Pasteurized skim was put in a processing vat, super heated, culture was added, and then pumped to the vats for cottage cheese processing.

- e) The operator discovered that they had used the last vat recorder chart the previous day. HTST charts were used on the vat recorder, since the charts included the normal pasteurization temperature range used by the plant of 160 degrees F.

9. Are any regulatory seals required on a vat pasteurizer? Y ___ N ___. Explain.

10. Provide the following vat pasteurizer thermometer criteria:

	<u>SPAN</u>	<u>° F grads</u>	<u>ACCURACY</u>	<u>Chart speed</u>	
Indicating	_____ ° F	_____ ° F	_____ ° F	_____ ° F	NA
Recording	_____ ° F	_____ ° F	_____ ° F	_____ ° F	1 rev/____hrs*
Air Space	_____ ° F	_____ ° F	_____ ° F	_____ ° F	

For Pasteurizers using temperatures greater than 160° F-see PMO, pages 217-220.

Indicating	_____ ° F	_____ ° F	_____ ° F	_____ ° F	NA
Recording	_____ ° F	_____ ° F	_____ ° F	_____ ° F	1 rev/____hrs*
Air Space	_____ ° F	_____ ° F	_____ ° F	_____ ° F	NA

*Except that strip charts may show a continuous recording over a ___hour period.

VAT PASTEURIZATION

10. List the four significant requirements for a vat pasteurizer outlet valve.

- a)
- b)
- c)
- d)

11. Explain the reasoning for the requirement that when pre-heated product is brought into a vat for pasteurizing, the filling time must be adjusted. How is this added time measured?

Notes:

VAT PASTEURIZATION