Processing Recommendations For Pasteurizing Meat From the Blue Crab

J. Winter Duersch
Michael W. Paparella
Ralph R. Cockey

Marine Products Laboratory
Center for Environmental and
Estuarine Studies
University of Maryland
Crisfield, Maryland

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CONTENTS

PREFACE

This report details handling, pasteurization and storage procedures that crab meat processors should follow to avoid contamination of the product and to maintain and improve the quality of the crab meat delivered to the marketplace.

The recommendations in this report are a revision of M. C. Tatro's 1970 *Guidelines for Pasteurizing Meat from the Blue Crab* (Callinectes sapidus). This update of Tatro's work reflects the latest research on destruction of Clostridium botulinum spores and also includes the 1971 Good Manufacturing Practices (GMP) recommendations developed by the Tri-State Seafood Committee. The GMP recommendations, the last submitted to the Food and Drug Administration dealing specifically with crab meat, are included here in their entirety.

Food technologists Dr. J. Winter Duersch and Michael W. Paparella and microbiologist Ralph R. Cockey prepared this report at the Marine Products Laboratory of the University of Maryland's Center for Environmental and Estuarine Studies (CEES). Mike Paparella, Senior Agent, and Ralph Cockey, Agent, work for CEES in extension service to the seafood industry; Dr. Duersch, formerly with CEES, now works for Griffith Laboratories in Chicago, Illinois.

I. INTRODUCTION

Who harvested the first blue crab (Callinectes sapidus) is not known, but blue crabs have since become a seafood delicacy of prime importance. They are harvested commercially from coastal and estuarine waters of all the Atlantic states from New Jersey to Florida and into the Gulf states.

Prior to the late 1800's, blue crabs were mainly sold raw as hard crabs or the more highly prized soft shell crabs. The sale of cooked, picked blue crab meat both fresh and pasteurized did not occur until later. A review of the history of blue crab processing reveals that crab meat canning began with James McMenanin's 1878 operation in Norfolk, Virginia (Ulmer 1964). Today, more than 90% of all crab meat is marketed in freshly cooked form. The blue crab meat that satisfies the gourmet palate in salads, crab cakes, crab imperial, crab stuffing and many other delectable dishes is most often canned. The convenience is as impressive as the quality. Handled, pasteurized and stored according to the techniques recommended here, cooked crab meat attains a shelf life of at least six months.

As with the majority of seafoods, blue crabs are harvested following the ancient patterns of hunting the wild living stocks in the water as nature provides them. They are taken in trotlines, in crab pots and sometimes scrapes and dredges. Most are harvested in crab pots. A waterman will fish up to 300-400 pots and land as many as 1500 pounds in a day. The crabs are caught in the morning; and because they cannot survive too long out of water, they are usually delivered to crab houses (plants) by early afternoon.

Because crabs obviously do not inhabit a sterile environment, they contain contaminating bacteria on the surface, gills, intestines and pharynx. Microbial levels on "raw" crabs have been reported to be as high as 450 million per crab (Tinker and Learson 1972; Webb et al 1973). This microbial contamination is an important consideration when the plant operator realizes the potential that the presence of bacteria might have on public health. Throughout the history of the product and especially during pasteurization, extreme care and proper handling practices must be exercised to ensure adequate pasteurization.

All foods begin to deteriorate immediately after harvest or slaughter. In fact, only live crabs should be used for processing, dead crabs having most likely deteriorated to a level making them unsuitable for human consumption. To combat this inevitable deterioration in the live crabs processed, the plant operator must be extremely concerned with bacteria levels. The cooking process and plant sanitation must reduce and control microbial contamination in order to produce crab meat with the desired shelf life and quality. Although some would like to believe that the pasteurization process alone would take care of any problems with bacteria prior to this step, this is not the case. If processing practices do not reduce contamination or maintain sufficiently low levels, the bacteria counts will be so high prior to pasteurization that the heat pasteurization process as prescribed cannot destroy sufficient numbers of microorganisms. The survivors can then grow and spoil the meat.

Heat treatment does not guarantee total destruction of microorganisms.

Rather, time-temperature schedules determine levels of destruction. When microorganisms in a given food are held at a lethal temperature, they die at a predictable rate which food scientists term the "D value," standing for "decimal reduction time." This D value designates the length of time needed at a specific lethal temperature to reduce the population of viable microorganisms to one-tenth, i.e., to kill 90 percent of the microorganisms present.

For example, if a given volume of food product inoculated with 1,000 bacterial spores of a certain type is heated at 235° F, and if at the end of five minutes 900 spores have been destroyed, the D value for this spore at 235° F is 5 minutes. Another five minutes at that temperature (a second D value) will kill 90 percent of the 100 spores remaining, so that after 2Ds, 99 percent of the spores will be killed and 10 spores will remain. After 3Ds, only one spore, or 0.1 percent of the original spore population, will remain.

In commercial canning, food technologists go well beyond the minimum theoretically needed to achieve a 90 percent kill of the spores present, or even a 99.9 percent kill. They determine, through extensive laboratory testing, the D value for each type of bacterial spore likely to be present, and then apply what they call the "12D" concept. Essentially this means that to achieve acceptable sterility in a canned low-acid food, the point in any can or jar slowest to heat must be heated for a period equivalent to 12D values for the most heat-resistant spores that might be associated with that particular food. In the above example, this would mean that in a given volume there would be only one chance in one billion that a microbial spore would remain which could survive, germinate and produce a toxin or spoil the product. Depending as it does on rates of destruction, the effectiveness of the heat pasteurization process is based on the assumption that bacteria levels are reasonably low before pasteurization.

Bacteria on the crabs are not the only source of concern for the crab plant owner; he must be concerned about any source of potential contamination in the entire process from the water to the consumer's table.

To this end, in 1971 the Tri-State Seafood Committee submitted a Good Manufacturing Practices (GMP) recommendation to the Food and Drug Administration (FDA). In the future, the FDA has no plans to issue new GMP's for specific areas of the seafood industry. Instead, the agency plans only revisions to the general food GMP to cover general procedures. For this reason and because of its value to the crab house operator and other interested parties, the specific GMP recommendation for crab meat processing as originally conceived by the Tri-State Seafood Committee is included here in its entirety. If followed, the GMP will maintain and improve the quality of the crab meat being delivered to the marketplace.

The stakes are high. The most recent statistics indicate that the 1979 commercial blue crab harvests in the United States totaled better than 140 million pounds yielding a dollar value of about 30 million. In addition to illustrating the economic importance of the blue crab industry, the numbers suggest to the crab processor an even more important consideration: the better the quality, the greater the potential return for the investment.

II. THE PASTEURIZATION PROCESS: AN OVERVIEW

The following overview of pasteurization of meat from the blue crab is based in part on the Tri-State Seafood Committee's GMP recommendations quoted in Section IV. The process can be divided into five steps:

1. *Cooking.* As soon after delivery of live blue crabs as possible, the crabs should be cooked under steam pressure of 15 psig (250° F) for 10 minutes or until the internal temperature of the centermost crab reaches 240° F. Unless crabs are cooked within 1-2 hours after receipt at the processing plant, they should be refrigerated at 45°-50° F. Figures 1 and 2 illustrate typical horizontal and vertical retorts, plus the essential components, used to cook crabs.

2. *Cooling.* Cooked crabs, after removal from the retort, must be air-cooled to room temperature without being disturbed. If not picked within 12 hours, they should be refrigerated at 35°-40° F or less. Cooked and raw crabs should not be stored in the same cooler. It is further recommended that crabs be stored in the same container in which they were cooked. It is essential that the cooked

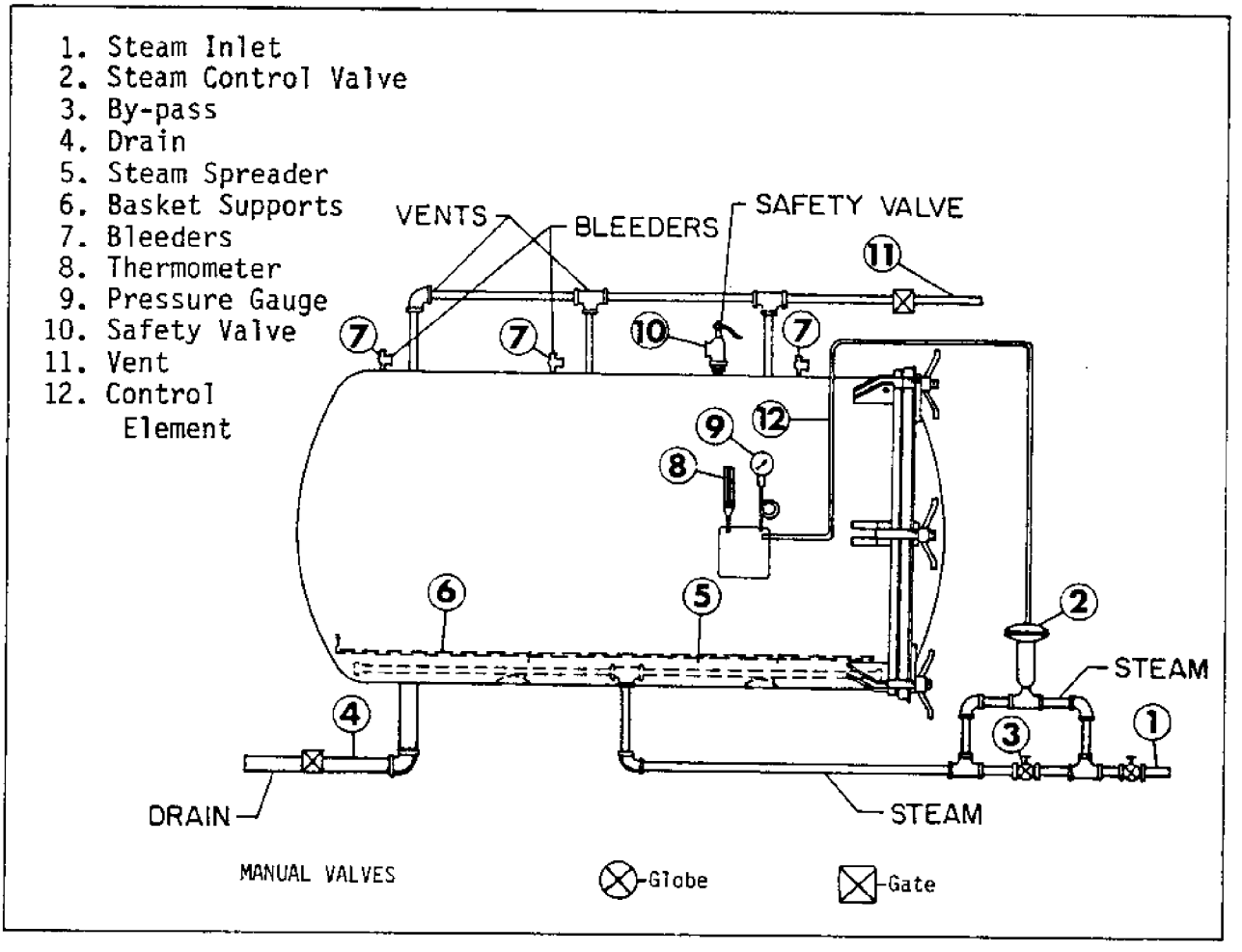

Figure 1. Horizontal Retort

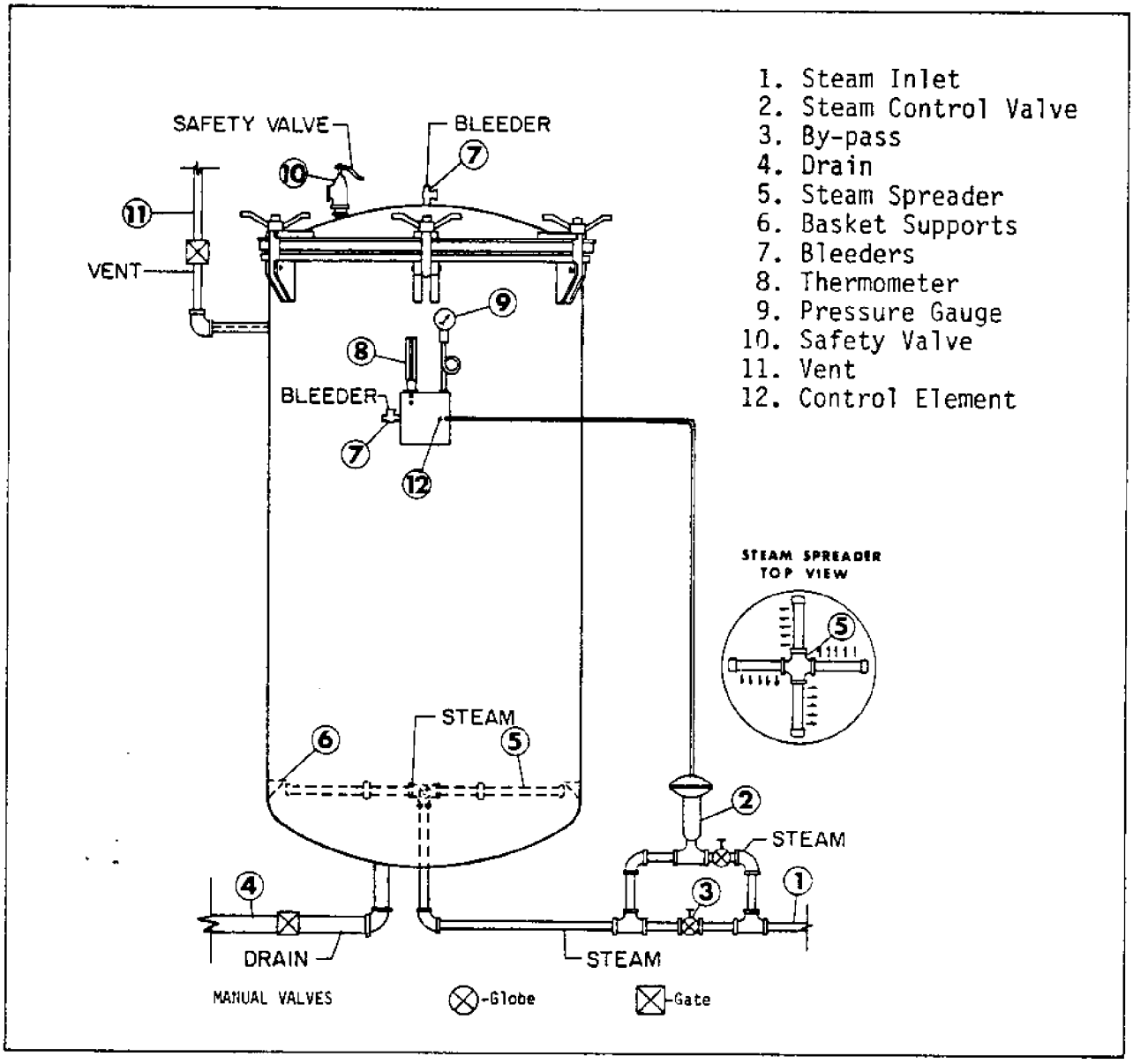

Figure 2. Vertical Retort

crabs be protected from contamination from all sources.

3. *Picking and Packing.* The picking and packing operations should also be performed such that contamination of the meat is avoided. Within one hour after picking, the crab meat should be delivered to the packing area and the cans sealed and placed in refrigerated storage. Usually the 401 flat can is used for pasteurized crab meat.

4. *Pasteurization.* Pasteurization is performed in a water bath. Figure 3 illustrates a typical pasteurization tank. The water temperature in the tank must be between 190°-192° F prior to introduction of the retort basket. Proper temperature and water circulation with

air must be maintained throughout the process. When 401 flat cans are used, the pasteurization time is usually between 110-115 minutes, recorded from the time the water temperature again reaches 190°-192° F after the cans have been immersed in the hot water bath. This allows the internal temperature at the geometric center of the can to reach 185° F for a minimum of 3 minutes (Lynt et al 1977). The internal temperature of a can being tested can be determined by using a thermocouple inserted into the can as shown in Figures 4 and 5, with the temperature monitored with a potentiometer.

5. *Refrigeration and Storage.* Upon completion of pasteurization, the cans of meat are cooled. If lithographed cans with steel ends are used, the cans are cooled in ice water to an internal can temperature of 90° F. At 90° F the cans have sufficient residual heat to dry the surface moisture and inhibit rusting of the cans. This requires 45 minutes and is

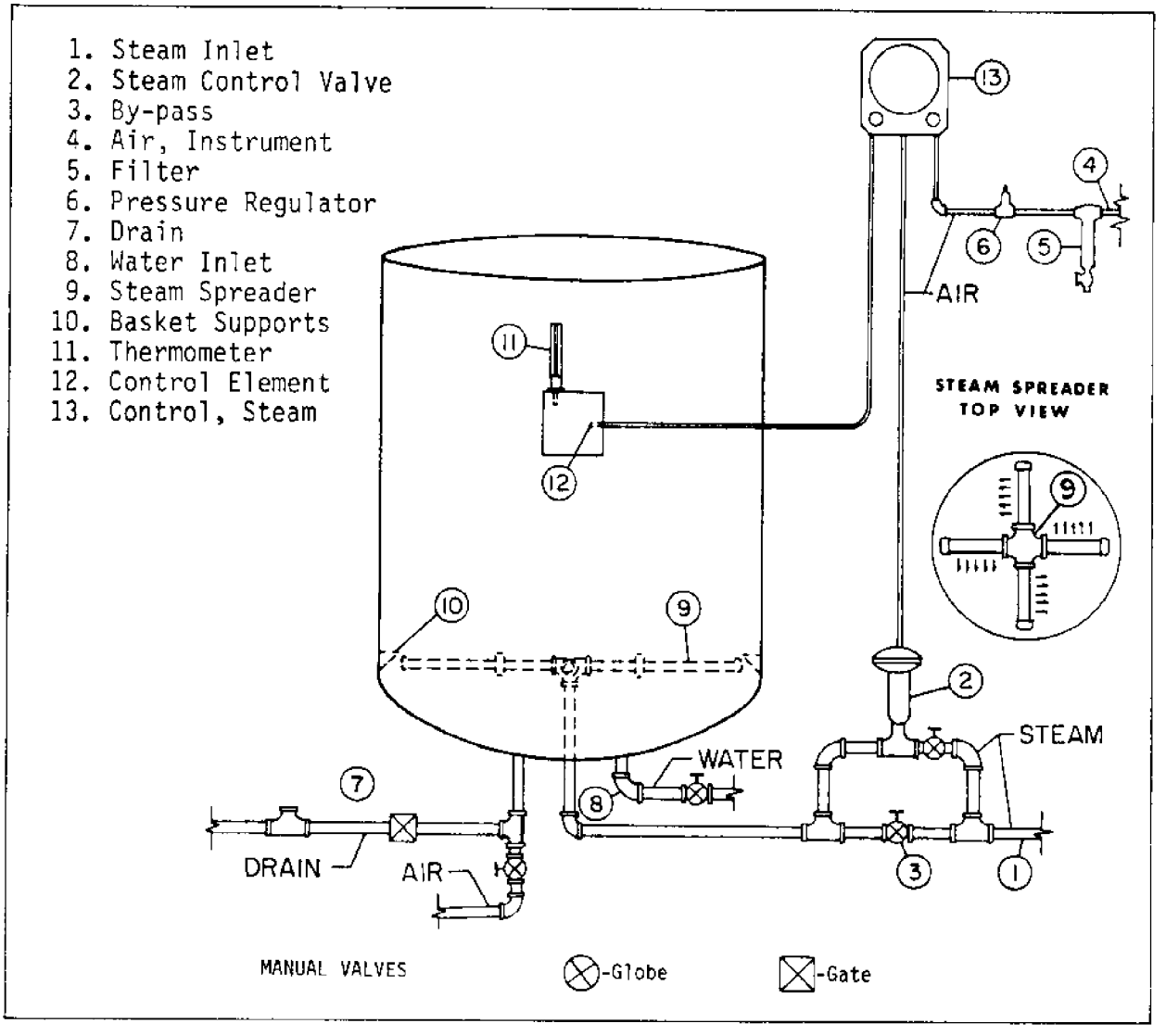

Figure 3. Pasteurization Tank

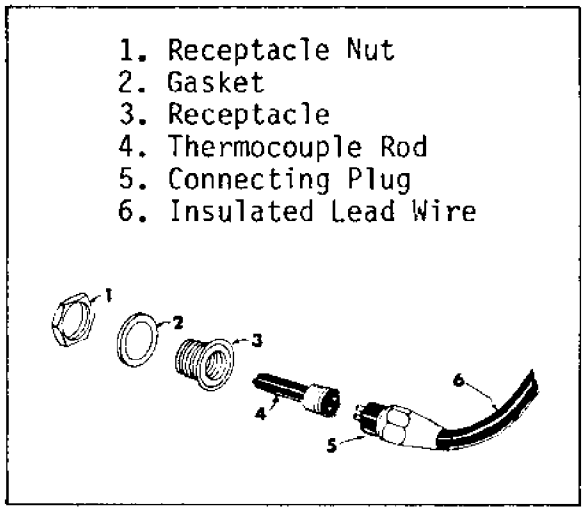

Figure 4. Nonprojecting Plug-In Thermocouple

usually performed in a tank similar to the pasteurization tank without the steam equipment.

If lithographed cans with aluminum ends are used, then the temperature may be lowered to the temperature of the cooling water, since no rusting will ensue.

Following cooling, the cans should be placed immediately into dry refrigerated storage for a minimum of 24 hours prior to packing into shipping cartons.

Pasteurized crab meat, whether in or out of shipping cartons, should be stored continuously below 38° F until consumed. This is the most important directive for storage. Shipping containers as well as product containers should conspicuously feature refrigeration storage instructions. Pasteurized and stored according to recommendations, pasteurized crab meat should have a shelf life of at least six months to a year.

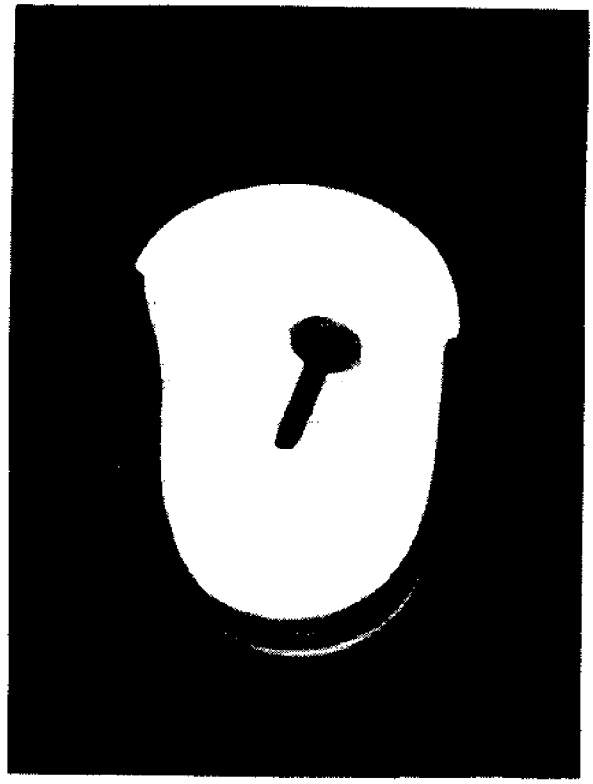

Figure 5. Cutaway of Can with Thermocouple

III. PROBLEMS, CAUSES AND SOLUTIONS

Any process is subject to problems at one time or another. The following are trouble shooting points indicating potential problems that, should they arise, can generally be solved without major procedural changes.

High Standard Plate Counts

The most frequent problem confronting crab meat processors is high bacteria counts found in the processed meat. It has been emphasized that if processing practices do not reduce or maintain low levels, the bacteria numbers will be so high prior to pasteurization that the pasteurization process as prescribed cannot destroy all the microorganisms present. The survivors can then grow and spoil the meat.

Another influence on the destruction of bacteria is the physical state of the crab. Certain stages in a crab's life cycle, for instance, may indicate potential problems for the processor. If a blue crab has recently shed (the buckram stage), there is little meat and a greater proportion of water, providing an ideal environment for bacterial growth. A gravid female crab, carrying an egg mass commonly known as a sponge, presents a slightly different problem. The sponge has an insulating effect, and spore-forming bacteria are able to survive the cooking process deep inside the sponge. In both cases, because of the more favorable conditions survival of bacteria, longer processing is required. When sponge or buckram crabs are held in the same containers with other crabs, the water dripping from these potentially bacteria-laden crabs contaminates the remainder of the basket of cooked crabs, which in turn contaminates the picked meat.

High microbial counts should not be a problem for the processor who is aware of the problems with buckram and sponge crabs and who follows the processing guidelines found in the GMP recommendations.

Processed Crab Meat Discoloration

The various types of discoloration observed in processed crab meat are described by D. D. Boon in a 1975 review article. Blue, brown, black and red discoloration may occur, and each type may be found in the same species of crab. The occurrence of the problem is found to be sporadic and unpredictable at times. Unfortunately, as Boon explains, agreement as to causes and cures of this problem has not been reached.

Excess heat processing has been considered the cause of blue discoloration, a blood constituent being the probable factor. Black coloration has been reported to be a reaction between volatile sulfide compounds and ferric ions dissolved from the can. However, the cures for discoloration are still uncertain and Boon's 1975 article remains the best resource for further study available to the concerned processor.

Can Deformation

Once the crab meat is hermetically sealed and pasteurized, the most obvious indication of trouble will appear in the can itself. The ends of normal cans will be slightly concave due to the vacuum created after processing. Ends which are not concave are an indication that either microbial, chemical or physical changes have occurred. Cans may progress through the flipper, springer, soft swell or hard swell stages.

A flipper is a can having both ends flat with insufficient vacuum to maintain this configuration, thus a sharp blow will cause an end to bulge. Both ends can, however, be pressed to their normal position. Springers are swelled cans with only one end bulged out. When pressed, this end will return to normal, but the other end will bulge out. In the soft swell stage, both ends of the can are swelled but may be depressed fairly easily by thumb pressure. The hard swell stage refers to spoilage in which both ends are swelled too hard to be readily depressed by applying thumb pressure.

Both microbial and chemical swells are caused by gas formation allowing the can ends to bulge. Physical swells occur when cans are overfilled during processing and expansion permanently distorts the can. The microbially caused swell is the most frequently observed. High microbial levels prior to pasteurizing or pinhole leaks or any other can failure may be the causes of this problem.

Proper handling and can sealing should remedy these problems.

IV. TRI-STATE SEAFOOD COMMITTEE GMP RECOMMENDATIONS

Terminology

1. Definitions

a. *"Backed" crabs.* Cooked whole crabs from which the top shell has been removed.

b. *"Bobbed" crabs.* Cooked whole crabs from which the top shell, legs and viscera have been removed.

c. *A certified plant.* One which complies with the requirement of the State Health Department and holds a valid permit from that authority.

d. *Crab meat.* The meat of the blue crab, Callinectes sapidus, steamed or cooked without further processing other than picking, packing, pasteurizing and chilling.

e. *Food-contact surface.* The parts of food equipment, including auxiliary equipment, which may be in contact with the food being processed, or which may drain into the portion of equipment with which food is in contact.

f. *Internal temperature.* Actual temperature of the interior of the animal or product as opposed to the ambient (surrounding) temperature.

g. *Overage.* Crab meat that is in excess of an even number of pounds delivered by the picker to the packing room.

h. *Pasteurization.* The term "pasteurization," "pasteurized" and similar terms shall mean the process of heating every particle of crab meat to a temperature of at least 185° F and holding it continuously at or above this temperature for at least three minutes in equipment which is properly operated and approved by the State Board of Health, provided that nothing in this definition shall be construed as barring any other pasteurization process which has been found equally effective and which is approved by the State Board of Health.

i. *Person.* The word "person" shall mean an individual, firm, association, organization, partnership, business trust, corporation, company or any public or private entity.

j. *Picking Plant.* The term "picking plant" shall mean any establishment or place in which crabs are steamed or cooked and the edible meat is picked therefrom and packed.

k. *Sanitize.* The term "sanitize" shall mean effective bactericidal treatment of clean surfaces of equipment and utensils by a process which has been approved by the State Board of Health as being effective in destroying vegetative cells of microorganisms of public health significance and in substantially reducing numbers of other microorganisms. Treatment shall be safe for the consumer and not detrimental to the product.

l. *State Board of Health.* The term "State Board of Health" shall mean the State Health Director or his authorized representatives.

Physical Plant and Personnel

2. Plant Arrangement

a. Plants in which crab meat is picked and packed shall, to the extent feasible, be located such that they will not be subject to flooding by high tides. If plant floors are flooded, processing shall be discontinued until after waters have receded and the facilities are cleaned and sanitized. (A minimum plant elevation of at least two feet above mean high water shall be provided in new plant construction.)

b. Picking and packing operations shall be carried on in separate rooms, except where otherwise authorized or required by the health authority having jurisdiction.

c. The delivery window shall be equipped with a smooth, nonporous, corrosion-resistant shelf of metal draining toward the picking room.

d. Picking and packing rooms shall be large enough to permit sanitary handling of crab and crab meat.

e. Rooms or lockers are provided which have adequate capacity for storing clothing aprons and other personal articles of employees.

f. Washing of whole, backed or bobbed cooked crab shall be done in an area approved by the health authority having jurisdiction.

g. Where there is retail activity, the area used by customers shall be partitioned off from the packing room.

h. A separate room shall be provided for the cooling of cooked crabs. It shall never be used for the handling and/or storage of uncooked crabs. The construction and arrangement shall give adequate protection to the cooked crabs from flies, insects, rodents, dust, plant traffic and the washing down operation. This room and refrigeration room for cooked crabs shall open directly into the picking room, or screened-in area or passageway through which crabs are transported after cooling.

3. Floors, Walls and Ceilings

a. Floors. All floors shall be of smooth materials and so constructed as to be easily cleanable and shall be kept clean and in good repair. Floors in cooling, picking, packing, cold storage and toilet rooms shall be of concrete or other equally impervious and easily cleanable material, and shall be sloped to drain. Joints between floors and walls should be coved to facilitate cleaning.

b. All walls and ceilings shall be of tile, concrete, cement plaster, concrete blocks, painted wood or equivalent material having a smooth, washable, light-colored surface.

4. Animal and Vermin Control Measures

a. The plant shall be so constructed as to prevent ready entrance of rodents, and there should be no evidence of rodents in any part of the plant.

b. Effective measures shall be taken to keep flies, rodents and other vermin out of the establishment and to prevent their breeding or presence on the premises. All openings to the outer air shall be effectively protected against the

entrance of the insects by self-closing doors, closed windows, 16-mesh or finer screening, air screen over doors or other effective means.

c. Rodenticides which are highly toxic to humans shall not be stored in crab meat processing plants and shall not be used except under the supervision of a licensed pest control operator or other qualified specialist. Rodenticide application should not cause contamination of crabs or crab meat. Rodenticides which have a low toxicity for humans should be identified, stored and used in such a manner as to prevent contamination of the product or ingredients and to cause no health hazards to employees.

d. Only those pesticides which have been properly registered with the U. S. Department of Agriculture and the State Department of Agriculture and approved for the purpose shall be used; such pesticides shall be used in accordance with the manufacturer's directions and shall be so handled and stored as to avoid health hazards.

5. Lighting

Work and storage areas shall be lighted to at least the intensity indicated as follows: for working surfaces in picking and packing areas--100 foot-candle illumination; for storage rooms including toilet rooms and cold rooms--25 foot-candle illumination (measured 30 inches above the floor). All lighting in picking and packing rooms shall be shatter-proof.

6. Heating and Ventilation

All rooms and areas shall be well ventilated by natural or mechanical means, and shall be heated, if necessary, to maintain a comfortable working temperature. Obvious exceptions to this recommendation exist where work areas must be cooled to temperatures which maintain product quality but may not be comfortable to workers.

7. Water Supply

a. The water supply shall be approved as safe by the responsible state authority or shall comply with the Safe Drinking Water Act (Public Law 93-523). Private water systems should be so constructed and operated as to be at least equal to the recommendations contained in the Environmental Protection Agency publications: "1974 Manual of Individual Water Supply Systems" and "1976 National Interim Primary Drinking Water Regulations." [1, 2]

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[1] Information concerning publications can be found in the literature cited section.

[2] The regulatory agency should collect water samples for bacteriological examination at not less than semi-annual intervals if the supply should be from a private source. In addition, samples for bacteriological examination should be collected from all new private sources of supply before they are used, and from repaired supply facilities after they have been disinfected. Bacteriological examination shall be made in conformity with the standard methods recommended by the American Public Health Association.

b. All air cooling, picking and packing rooms shall be provided with water outlets.

c. An automatically regulated hot-water system shall be provided which has sufficient capacity to furnish water with a temperature and pressure suitable for all plant operations and employee sanitary facilities.

d. Sufficient water shall be available for all plant needs. Nonpressure supplies will not constitute compliance.

e. Hot and cold water outlets shall be provided at each sink compartment, except that only warm water may be acceptable at handwashing sinks.

f. Water from an unapproved source shall not be used in any part of the plant, or in the cooking and dock area where cooked crabs are handled in any manner.

8. Plumbing and Related Facilities

a. Plumbing shall be installed in compliance with State and local plumbing ordinances or substantially equivalent to the recommendations contained in the American Standard National Plumbing Code ASA a40.8-1955.

b. There shall be no cross-connections between the approved pressure water supply and water from a non-approved source, and there shall be no fixtures or connections through which the approved pressure supply might be contaminated by back siphonage.

c. There shall be at least one lavatory for every 20 employees among the first 100 employees, and at least one lavatory for each 25 employees in excess of the first 100. When a lavatory is provided with water outlets for each space, 24 lineal inches of wash sink or 18 inches of a circular basin will be considered equivalent to one lavatory.

d. Handwashing facilities shall be convenient to the work areas and so located that the person responsible for supervision can readily observe that employees wash their hands before beginning work and after each interruption. Ordinarily, there should be at least one lavatory in the packing room for use by packing room workers.

e. The lavatories shall be provided with hot water (at least 100° F) either from a controlled temperature source with a maximum temperature of 115° F or from a hot-and-cold mixing or combination valve. Steam-water mixing or steam-water combination valves are not acceptable.

f. Supplies of soap and single service hand towels shall be available near the lavatory. Other sanitary drying devices if approved by the state regulatory agency are also acceptable.

g. Appropriate handwashing signs shall be posted in toilets or privies, at conspicuous places in both packing and picking rooms, and at the handwashing lavatories.

h. Privies and outside toilets shall be fly-proof with self-closing doors opening outward.

i. The toilet rooms shall be kept clean and in good repair.

j. A supply of toilet paper shall be available in the toilet rooms.

k. At least 25 foot-candle illumination (natural or artificial) shall be provided in toilet rooms; and toilet rooms should be ventilated by a direct opening to the outer air or by a mechanical ventilating system. Exhaust fans, if used, should have a minimum capacity of 2 cubic feet a minute per square foot of floor area. Air vents should be screened or have self-closing louvers.

l. Conveniently located, separate toilets shall be provided for each sex, excepting that separate facilities need not be required when a family operation is carried on and satisfactory toilets are located nearby or when the plant has fewer than 10 employees. The number of water closets provided should comply with applicable state laws. In the absence of such laws, the following number of water closets should be provided:

Employees	Water Closets[a]	
	Male	Female
1 to 9	1	1
10 to 24	2	2
25 to 49	3	3
50 to 74	4	4
75 to 100	5[b]	5[b]

a Whenever urinals are provided, one water closet less than the number specified may be provided for each urinal installed, except that the number of water closets in such cases should not be reduced to less than two-thirds of the minimum specified. A 24-inch trough will be considered equivalent to 1 urinal.

b One additional fixture for every 30 employees over the first 100.

m. No drainpipes or wastepipes shall be located over food processing or storage areas or over areas in which containers or utensils are stored or washed.

n. Plumbing facilities and equipment shall be so constructed and so located as to permit no splashing of water onto picking tables, packing tables or any food or food contact surfaces.

o. This equipment shall be so placed as to facilitate the flow of plant activities and in relation to use, while at the same time avoiding crowded conditions.

p. Adjacent to these lavatories, a container of suitable construction shall be provided for the sole purpose of sanitizing the hands in an approved solution of adequate strength.

9. Sewage Disposal

a. Sewage shall be discharged into public sewers wherever possible.

b. Any private sewage-disposal facilities utilized shall be constructed and operated so as to comply with state and local requirements. Privies are accepted only where water-carriage systems are unfeasible. Any newly constructed individual water-carriage systems should be at least equal to the recommendations contained in the "Manual for Septic Tank Practice," Public Health Service Publication No. 526.

c. No human excreta shall be accessible to flies or rodents.

d. All sewage and other liquid wastes shall be disposed of in such a manner as not to create a nuisance or degrade water quality or constitute a source of product contamination. On new construction, wastes from hand wash and utensil wash sinks shall not be discharged overboard without proper treatment.

10. Construction of Utensils and Equipment

All equipment and utensils shall be of such design and of such material and workmanship as to be smooth, easily cleanable and durable. Equipment shall be kept in good repair; and the food-contact surface of such equipment and utensils, shall, in addition, be nontoxic, corrosion-resistant, nonabsorbent, easily accessible for cleaning and free of open crevices.

11. General Cleanliness

a. Material and equipment not in routine use shall not be stored in rooms for air-cooling, picking, packing, cold storage or container storage.

b. The processing areas of the plant shall not be used for other operations while crabs are being processed.

c. Only personnel employed by the plant, authorized inspectors or other persons specifically authorized by the plant managers shall be allowed in the processing plant during periods of operation.

d. Premises should be clean and free of litter and rubbish.

12. Cleaning of Building and Equipment

a. The plant interior shall be kept clean and all utensils and equipment shall be thoroughly cleaned at the end of each day's operation and more often if necessary. Food-contact surfaces shall also be sanitized at the end of each day's operation, immediately prior to the start of the new day's operation and whenever necessary. After being cleaned or sanitized, utensils and equipment shall be so stored or protected as to minimize the possibilities of contamination. Sanitized shovels shall not be stored on the floor. Picking pans and knives shall be cleaned and rinsed in a bactericidal solution frequently during the day's operations, such as after each trip to the receiving window of the packing room.

b. Necessary facilities shall be provided and used for the cleaning and sanitizing of utensils and equipment, including a three-compartment wash sink of adequate size with hot and cold running water piped to each compartment. A three-compartment sink is recommended to permit washing, rinsing and sanitizing of utensils and equipment in a separate compartment for each step.

c. A one-compartment sink with drainboard and hot and cold water connections located in or convenient to the packing room for sanitizing shipping cans shall be provided.

d. Water heating facilities shall be provided, with sufficient capacity to supply hot water at temperatures required for cleaning and sanitizing during all periods of operation.

13. Health of Personnel

a. Before permitting any person to work, the management shall require that each employee submit and keep on file with the management, a medical health certificate properly signed. All certificates of medical examination shall certify that the individual has no evidence of a communicable or infectious disease, which shall constitute the minimum standard of the state agency having jurisdiction.

b. Daily observations or inquiries of employees shall be made by the managers or supervisors to detect any sign of illness among employees.

c. A report shall be made to the local health authority when an employee is known or suspected of having a disease in a communicable form.

d. Employees shall wash their hands thoroughly with warm water and soap, then dip them in an approved sanitizing solution before beginning work and prior to returning to work after leaving working areas, or after contact with any unprotected surface or other source of contamination. Following washing, employees engaged in picking and packing operations shall rinse their hands in a clean sanitizing solution containing effective bactericide. Fingernails shall be short and clean, and rings shall not be worn while picking.

e. The management shall post handwashing signs in conspicuous places in the picking, packing and toilet rooms. Clean, individual, disposable towels shall be provided for each picker to use during picking operations.

f. Pickers, packers and handlers of unpicked cooked crabs or picked meat shall wear clean outer garments and aprons. Aprons shall cover the front and sides of body. Caps or hair nets shall cover the hair. Arms shall be bare to the elbow or covered with approved arm guards. Any type of protective clothing employing ruffles and gathering of material shall not be used.

g. Employees shall not eat, drink or use tobacco in any form in the picking or packing rooms or any other area where the product may become contaminated.

h. The owner or manager shall either personally supervise or shall designate an individual whose principal duty shall be to supervise and be responsible for compliance with these regulations.

14. Methods of Bacteriological Treatment of Cleaned Utensils and Equipment

All food-contacted surface shall be treated by one or more of the following methods:

a. Exposure for at least 15 minutes at a temperature of at least 170° F or for at least 5 minutes at a

temperature of at least 200° F in a steam cabinet equipped with an indicating thermometer located in the coldest zone. (Absence of a thermometer violates this item.)

b. Immersion for at least 2 minutes in, or exposure for at least one minute in, a solution containing not less than 50 parts per million of free chlorine. All product-contact surfaces must be wetted by the bactericidal solution, and piping so treated must be filled. Bactericidal sprays containing not less than 100 parts per million of free chlorine may be used for large equipment. Bactericidal treatment with chemicals is not effective unless the surface has been thoroughly cleaned.

c. Bactericides other than chlorine should not be accepted by the inspector until official tests by the proper regulatory authority have demonstrated that the bactericide in question is satisfactory for use in connection with shellfish sanitation. The local inspector should consult his state health organization regarding other bactericides in use in his area so that he may be certain he is using the proper tests for effectiveness and concentration.

15. Storage of Equipment

Equipment and utensils which have been cleaned and given bactericidal treatment shall be stored so as to be protected against contamination.

Crab Processing

16. Refrigeration of Fresh Crabs

a. Only live crabs should be accepted for processing.

b. Unless crabs are cooked within 1-2 hours after receipt at the processing plant, they should be refrigerated at 45°-50° F.

c. Crabs may be washed before processing.

17. Cooking

a. Procedure

(1) Cull out dead crabs before cooking.

(2) Cook crabs under steam pressure at 250° F (15 psig) for sufficient time for internal temperature of the centermost crab in retort crate to reach 240° F. This period of time is normally 10 minutes in conventional horizontal or vertical retorts in use.

(3) Begin timing the cook only after retort has been properly vented, and the temperature has reached and maintained at 250° F after vent valve is closed.

b. Equipment

(1) Boilers must operate at no less than 100 psig and drop no lower than 45 psig during the cooking operation.

(2) Steam line to retort should not be less than 1-1/4 inch internal diameter (i.d.), but preferably 1-1/2 inch i.d., and should enter at base of retort. Steam distribution within the retort must be by means of one inch i.d. perforated pipe forming a cross on bottom of vertical retort or straight pipes along opposite sides of horizontal retort. The perforations are 1/8-inch diameter and drilled so they face vertical wall of retort.

(3) The retort must be housed under a permanent roof and join the cooling room. The retort must be equipped with the following:

(a) Indicating thermometer, mercury filled, enclosed, 7 to 9 inches long, range 170-270° F, located with bulb extending into heating chamber of retort.

(b) Pressure gauge, 0-30 psig range, 3 to 4 inches in diameter and located adjacent to thermometer.

(c) Safety pop-off valve operational at 18 to 20 psig and located on cover to vertical retort or top surface of horizonal retort, appropriate to the operator's personal safety.

(d) One-inch diameter gate or globe valve on cover or top surface of retort for venting in order to provide complete steam environment within retort.

(e) One-quarter inch diameter petcock on cover or surface of retort for continuous bleeding of steam during the cooking cycle.

(f) Two-inch diameter gate or globe valve at bottom drain pipe of retort.

(g) Retort cooking baskets must be of stainless steel and so designed to allow for adequate steam distribution among all the crabs within the basket and to allow for easy handling, dumping and cleaning.

(h) All overhead hoists must be equipped with a chainbag, where applicable, to eliminate contact of greased chain with raw or cooked crabs.

(4) Cooking Cycle

(a) At start of cooking cycle, when steam is first introduced into retort, vent valve should be opened wide for 2-3 minutes to allow escape of residual air in retort. Vent valve is then closed and bleeder valve is opened wide for duration of cooking cycle.

(b) Drain valve at bottom of retort is opened and kept open sufficiently to eliminate the constant accumulation of liquid formed from steam condensation and the body fluids released from crabs during cooking.

18. Cooling

Cooked crabs, after removal from the retort, must be air cooled to room temperature without being disturbed. Cooked crabs must be

placed under refrigeration at 35°-40° F if not picked within 12 hours following cook. Cooked crabs must be protected from all contaminants and must be stored in original retort cooking basket.

19. Picking and Packing

a. The picking and packing operations shall be conducted in a sanitary manner. Picked crab meat shall be placed directly into consumer package, such as the 401x301 can, and be delivered to the packing room or packing area promptly within one hour of picking or immediately upon the accumulation of not more than five pounds. Immediately after packing, containers of cooked crab meat shall be sealed, iced and placed in refrigerated storage.

b. "Overages" shall not be returned to pickers.

c. Repacking of crab meat which has been picked or processed in another plant shall not be allowed.

d. Mixing or blending of fresh, frozen or pasteurized crab meat shall not be allowed.

e. Cans or other containers for packaging cooked crab meat shall be clean, single-use, made of impervious material and capable of being hermetically sealed.

f. Packer's certificate number shall be legibly impressed, embossed or lithographed in or on the sides of single-service containers in which crab meat is packed. The only exception is when the lid becomes an integral part of the container during the sealing operation; then the number may be on the lid. In any case, the name and address of the firm or distributor shall be similarly marked on the container or lid. Plastic bags shall have the name and address of the packer or distributor and certification number of the packer permanently marked on them. (Hand-stamping is unacceptable). Containers bearing a certificate number other than that of the respective plant shall not be allowed in plant.

20. Coding

Permanently legible code marks shall be located at a readily visible area on each finished container delivered or displayed to purchasers so that the code markings can be readily seen on the unopened container or package. The marks shall identify as a minimum the plant where packed and the lot or packaging lot. This requirement does not apply to over-the-counter retail sales at the site of manufacture.

21. Record Keeping

a. The processor shall maintain records of results of examinations and/or copies of suppliers' guarantees or certificates that verify compliance with Food and Drug Administration regulations, guidelines or action levels of raw materials, food-packing materials, and finished foods.

b. Processing and production records of the pasteurization process shall be maintained and contain sufficient information to permit public health evaluation of the product.

c. Distribution records shall be maintained to identify the initial distribution of the finished product to aid, when necessary, the segregation and recall of specific lots that have become contaminated or otherwise unfit.

d. Records required by paragraphs a, b, and c of this section shall be retained for a period of time exceeding the shelf life of the pasteurized crab meat or not to exceed 2 years from the date of pasteurization.

22. Crab Scrap Disposal

Scrap containers shall be removed from the picking room as soon as they are filled, and scrap shall be stored in covered containers and shall be removed from the premises at least daily and disposed of in such a manner as to prevent a nuisance and source of contamination. All scrap containers shall be leakproof and of nonabsorbent materials and shall be thoroughly cleaned at least daily. Other solid wastes shall be stored and disposed of with sufficient frequency and in such a manner as to prevent a nuisance and contamination.

23. Handling of Single-Service Containers

All single-service containers shall be stored and handled in a sanitary manner and, where necessary, shall be given, immediately prior to filling, bactericidal treatment such as dipping each container in a 200-ppm chlorine bath or 25-ppm iodoform solution. Dipping solutions should be changed to maintain adequate bactericidal strength.

24. Refrigeration

a. Refrigeration rooms for the packed product shall be of sanitary construction with an impervious floor graded to drain quickly. The room shall be so constructed that it will not receive drainage from other portions of the plant. Floor drains shall not be connected directly to a sewer. Raw crabs or fish or related items shall not be stored in this room. An exception is allowed when the room is large enough that a part may be partitioned off for the storage of these items, provided that the partition is at least four feet high and constructed of impervious, easily cleanable material and that drainage from this part does not reach the packed product area. Product, whether packed or raw, shall not be stored on the floor.

b. Ice boxes for the picked product will be of sanitary construction with an impervious lining and an effective drain.

c. The refrigeration room or ice box shall be large enough and so constructed that a full day's production, with ice, can be conveniently stored and equipped with an acpurate indicating thermometer located in the room or box.

d. Ice shall preferably be manufactured in the plant; otherwise, it shall be obtained from an approved source. Packers purchasing crushed ice shall secure it from dealers who handle, crush and deliver it in a sanitary manner.

e. Ice bins shall have smooth, impervious ice-contact surfaces and shall be so constructed and lo-

cated that the bottom is above the level of the adjacent floor and drains away from the unused ice.

f. Block ice shall be properly stored to avoid contact with contaminated surfaces and shall be thoroughly washed on an elevated metal stand or grating with a hose provided for this purpose before it is placed in the crushing machine. A corrosion-resistant container shall be provided to catch the crushed ice falling from the crusher. (Where the crusher is located in a protected portion of the refrigeration room, this container is not required.)

g. All facilities and equipment employed in handling and/or preparing ice for use shall be used for no other purpose and shall be cleaned each day the plant is in operation. Shovels shall be hung or stored in a protected manner when not in use.

h. Where it is necessary to have ice in the packing room, a metal-lined container or compartment of sanitary construction shall be provided for the sole purpose of storing ice manufactured in the plant or purchased crushed ice or block ice that has been crushed in the plant. Lined or unused clean wooden barrels for shipping crab meat may be used for this purpose.

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